Pit and Quarry

With which is consolidated CEMENT-MILL & QUARRY

Member Audit Bureau of Circulations

Read in Largest Number of Plants

Vol. XXIII December 2, 1931 No. 5

Published bi-weekly on Wednesday for producers and manufacturers of Cement, Crushed Stone, Gypsum, Lime, Sand, Gravel and other non-metallic minerals. Entered as second-class matter October 9, 1928, at the Postoffice at Chicago, Ill., under the Act of March 3, 1879.

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Vol. XXIII CHICAGO, DECEMBER 2, 1931 No. 5

P. C. A. Holds Annual Meeting at Chicago

F. H. SMITH HEADS DIRECTORS

Frank H. Smith, president of the Lawrence Portland Cement Co., was elected chairman of the board and Charles F. Conn, head of the Giant Portland Cement Co., was named treasurer at the twenty-ninth annual meeting of the Portland Cement Assn. held Nov. 17 and 18 at the Blackstone Hotel, Chicago.

New members elected to serve on the board of directors include J. D. Johnston, Canada Cement Co., Ltd.; John J. Porter, North American Cement Corp.; W. S. Speed, Louisville Cement Co.; John Treanor, Riverside Portland Cement Co.; L. T. Sunderland, Ash Grove Lime & Portland Cement Co.; and H. F. G. Wulf, Monarch Cement Co. Active direction of the affairs of the association continues to rest in the hands of Edward G. Mehren, president, and William M. Kinney, general manager, no changes in these positions having been made by the directors at the meeting. About 300 representatives of 40 member cement companies attended the gathering.

The principal meetings, open only to representatives of member companies, were devoted to discussions of technical problems and plant practice on the morning of Wednesday, Nov. 18, and to hearing reports of standing committees on Wednesday afternoon. Committee meetings were held on the previous day, Tuesday, Nov. 17, and the formal dinner, an annual affair, took place in the ballroom of the hotel on Wednesday evening. Judge Henry Horner of Chicago was the guest speaker.

The featured paper of the convention was "Combustion Control for Cement Kilns," presented by Albert W. Cox, experimental engineer of the North American Cement Corp., Albany, N. Y.

Hydraulic-Cement Plant Badly Damaged by Blaze

Fire of unknown origin caused damage of $25,000 recently to the main plant of the Ft. Scott Hydraulic Cement Co. at Ft. Scott, Kan. Most of the machinery was ruined by the intense heat. The loss, however, was covered by insurance, according to Howard Thomas, president, who reports that the company will begin rebuilding immediately. This is the second time the Ft. Scott plant has been visited by a disastrous fire, the previous blaze having occurred about 30 years ago.

Oppose Any Increase in Taxes on Motor Trucks

Opposition to any increase in tax on commercial motor vehicles was vigorously supported by the National Industrial Traffic League in a convention at Chicago Nov. 18-20.

"Taxation of commercial vehicles should not exceed a fair rate to cover their proportionate share of the cost of building and maintaining the highways that they use. It should not be undertaken in the spirit of penalizing one type of carrier as against another," said the League's report, which was unanimously approved.

New Cement Company Has $1,500,000 Capital

A charter of incorporation has been granted at Jackson, Miss., to the Mississippi Portland Cement Co. with a capital of $1,500,000. Incorporators named were Andrew Fitzpatrick of New Orleans, president; J. M. Evans of Jackson, vice president; and Frank Duffey of Natchez, secretary and treasurer.

It has not been announced just where the company will locate, but it is rumored that the town of Starkeville will be the location if the company ever reaches the stage of building a plant. A number of Starkeville persons are named on the board of directors. Limestone deposits in the Starkeville area are said to range from 2 ft. to 800 ft. deep.

Monolith Cement Takes Title to Adjacent Land

The Monolith Portland Cement Co. has acquired approximately four acres of land near its plant at West Glendale, Cal., where the complany plans the erection, shortly, of a new office building and additional storage facilities.

Two Portland-Cement Firms' Output Higher

INCREASE IS A HOPEFUL SIGN

Two Portland-cement producers report higher production and shipments in September and October as compared with the same months of last year.

An increase of more than 160,000 bbl. is reported by the Great Lakes Portland Cement Co., of Buffalo, for September and October over the corresponding months of last year. Adam L. Beck, president stated that, "November production will likewise show a gain over the same month of 1930."

October production amounted to about 179,000 barrels, an increase of 50,000 barrels over October, 1930.

Cement shipments of the Marquette Cement Manufacturing Co. of Chicago for October were 25 per cent. greater than for the same month of 1930, it was announced by Theodore G. Dickinson, president. The greatest amount ever handled by the company in one day was a peak reached on Oct. 3 when it broke its own record by shipping 55,000 bbl.

Aggregates Firm Is Formed at Binghamton

The Binghamton Crushed Stone & Gravel Corp. has been formed at Binghamton, N. Y., to succeed the firm of Frank J. Boland, Inc., which formerly operated several gravel and crushed-stone plants in that vicinity. Considerable expansion is planned for the next year, according to press reports from Binghamton. The company owns several hundred acres of sand-and-gravel deposits mostly along the Chenango River.

To Reöpen Iowa Quarry Abandoned 45 Years Ago

The Iowa State Highway Commission is to reopen a quarry that has been idle for 45 yrs. at Macedonia, Ia., with Weaver & Co., Iowa Falls, Ia., holding a contract for removing and crushing rock for road-surfacing work. The properties involved are owned by Willoughby Dye and W. E. Smith.

English Cement Firm to Erect Huge Plant

1,000,000-BBL. ANNUAL CAPACITY

Edgar Allen & Co., Ltd., Sheffield, England, have been awarded a contract by Cement Industries, Ltd., for the erection of a Portland-cement plant near Lewes, Sussex. The plant is designed for an ultimate capacity of about 1,000,000 bbl. per year and will comprise three units of 350,000-bbl. capacity each, the first of which is now being installed.

The new plant will concentrate on the production of quick-hardening cement and will be equipped with the most modern equipment including recuperator-type rotary kilns, Rexman balanced-rod mills and Fuller-Kinyon cement-conveying systems.

In addition, a Schulthess hydrator is being installed at the lime plant operated by the company, which is being enlarged.

Tennessee Gravel Firm Complains of High Rates

The East Tennessee Sand & Gravel Co., Elizabethton, Tenn., has filed a complaint with the Interstate Commerce Commission against the Southern Railway, alleging unjust and unreasonable rates on sand and gravel, in car-loads, from Elizabethton to points in Virginia.

The destination territory outlined in the complaint lies south and west of Roanoke, Va.; between Norton and Bristol, Va., on the west and Roanoke on the east, and to all stations on the main and branch lines of the Norfolk & Western Railway west of Petersburg, Va.

The complaint alleges that rates from Petersburg to the destination territory are considerably lower than corresponding rates from Elizabethton, to the detriment of the complainant. The commission is asked to prescribe just and reasonable rates for the future and to award reparation on past shipments.

To Distribute Limestone from Port of Muskegon

Muskegon has been selected as the new western Michigan distributing center of the Inland Lime & Stone Co., subsidiary of the Inland Steel Co. Freighters will bring cargoes of limestone from the company's new $5,000,000 quarries opened last spring at Port Inland.

The stone will be handled at Muskegon by the Great Lakes Foundry Sand Co., of Detroit, over the Construction Materials Corp. docks. It will be shipped throughout western Michigan by rail at a considerable saving to foundries and blast furnaces previously receiving the stone by rail from Indiana Harbor, Ind., or Detroit.

Clarence B. Randall, of Chicago, is president of the company. Gordon W. Hughes, of Chicago, is operating manager and George J. Nicholson, also of Chicago, is vice-president.

Producer in New Jersey Attacks Rates on Stone

The M. J. Grove Lime Co., Lime Kiln, Md., has filed a complaint with the Interstate Commerce Commission attacking freight rates on crude, fluxing, foundry or furnace limestone, in car-loads, from Stephens City, Va., to destinations in Virginia, Maryland, Pennsylvania, West Virginia, Ohio and Delaware.

According to the complaint, the rates from Stephens City to destinations in the states named are higher than the rates from Thomasville and Williamson, Pa., Engle and Martinsburg, W. Va., and other near competing producing points.

New California Silica Operations Are Started

About twenty-five men have been employed at the new silica-sand operations of the Pacific Coast Sand & Silicate Co. at Byron, Cal. The deposit, which was acquired some time ago, is said to be of especially high quality, particularly for glassmaking purposes, and the erection of a glass plant in that vicinity is contemplated within the next year by an eastern concern, according to reports.

Texas Quarries Co. Has New Plant in Operation

The Texas Quarries Co. has completed the erection of its new plant near Kingsland, Tex., and has started operating. The stone is a typical Texas granite and shipments are being made over the Southern Pacific Railway, which recently erected a spur track to the plant. The new operations are situated about 100 miles northwest of Austin, Tex.

Graphite Producer Adds New Equipment at Mines

The Annandale Graphite Corp. of Annandale, N. J., is carrying out expansion and improvements at its mines, preparatory to resumption of operations at the plant. New hoisting, conveying and other equipment is being installed. Harold D. Tonkins of Clinton, N. J., is general manager.

Leases Dock at Indiana Port as Storage Center

John H. Lutz, owner of the Harbor Coal Co., of Michigan City, Ind., has leased his dock next year to the Material Service Co. of Chicago, to be used as a storage and distributing center for sand, gravel and stone. The dock has a capacity of 8,000 tons.

Ben Stone Chosen to Head Hoosier Assn.

ANNUAL CONVENTION IS HELD

Ben Stone, general manager of the Merom Gravel Co., Indianapolis, Ind., was elected president of the Indiana Sand & Gravel Assn. at its annual meeting held at the Claypool Hotel, Indianapolis, on November 6. Mr. Stone succeeds Wm. H. Sanders of the Western Indiana Gravel Co. of Lafayette who had served the association as its president for the last two years.

Other officers named at the meeting were Ben E. Neal, of the Neal Gravel Co., Mattoon, Ill., vice-president; Charles F. Connelly, of the Terre Haute Gravel Co., Terre Haute, Ind., secretary; and Charles Purdum, of the Sturm & Dillard Co., Syracuse, Ind., Lee Witty, of the Wabash Sand & Gravel Co., Terre Haute, Ind., and Mr. Sanders, directors. S. C. Haddon was reëlected executive secretary.

The gathering was attended by forty-five Indiana producers. Representatives of the Indiana State Highway Department were presented, including William J. Titus, engineer, and Arthur Smith, assistant materials engineer. Proposals toward increasing the flexibility of state highway specifications were heard.

Ford Acquires Options on Limestone Deposits

Options on approximately 7,000 acres of limestone deposits near Cedarville, Mich., in the upper peninsula of the state have been acquired by the Ford Motor Co., according to reports from Iron Mountain, Mich. It is believed that the deposits will ultimately be purchased to provide stone for the Ford furnaces at Gladstone, Mich., and Detroit in future years.

Seeks Site for Building New Mica-Grinding Mill

J. W. Magnuson, president and general manager of the Western Mica & Feldspar Co. of Denver, conferred with officials of the Denver & Rio Grande Railroad Co. recently in relation to a concession from the railroad for a site near Soda Point, Colo., upon which the company plans to build a mill for grinding mica and feldspar and for the preparation and shipment of the material for market.

New Ready-Mix Concrete Producer at Dayton, O.

Announcement has been made of the organization of the Ready-Mixed Concrete Corp., of Dayton, O., by Alfred W. Kimmel, president of the new firm, and the plant for the preparation of completely mixed material is now being constructed. It is planned to begin operations before the end of the year.

Best Bros. Revamping Sun City Operations

TO LOWER PRODUCTION COSTS

Extensive changes in operating methods are being made at the Sun City, Kan., operations of the Best Bros. Keene's Cement. Strip mining is being discontinued in favor of the underground method and considerable new equipment is being added to improve as well as lower the cost of production. Raw materials, after crushing, are shipped to the company's processing plants at Medicine Lodge, Kan.

"These changes, the cost of which will run up into six figures, are the most comprehensive ones that we have ever made at that at our Sun City operations," according to John C. Best, president. "We have abandoned all our open quarrying operations and equipment and now have two underground mines in operation. One of these is a more or less experimental proposition that we started a year ago in order to familiarize ourselves and our employees with this type of work while the other is the permanent mine from which we expect to obtain practically all our rock in the future. As we have core drilled over 20,000,000 tons of rock on something less than half of the area that it will serve, it should hold us for a good many years.

"The mines go in a horizontal plane from the floor of the old quarry pits. We, therefore, have no shafts to bother about except for ventilation purposes. We have a seam about 22 ft. in thickness with a 6-ft. sandstone cap and about 50 to 80 ft. of overburden on top of that and, as the whole thing can be worked on one level, it forms almost an ideal operation.

"We are also abandoning the aërial tramway that we have used in the past and all our narrow-gauge railway except that portion of it that serves the mines. Our operations have been gradually moving away from their original location to a point where the amount of rolling stock and labor involved and the cost of transportation over the narrow-gauge line was increasing our costs to an undesirable extent.

"In place of the cableway and railroad we are running a standard-gauge switch directly to the new crusher plant located at the south of the permanent mine from the main line of the Santa Fe Railway about 2¼ mi. distant. This switch will come into a canyon about 60 ft. below our rock level, so that it gives us an excellent gravity proposition through the crusher, screen, bins and into the car.

"In place of the two primary and two secondary crushers that we have been using, we are putting in one large Jeffrey single-roll crusher with a capacity of 200 tons per hour. The Roberts & Schaeffer Co. of Chicago is furnishing the automatic weighing, dumping and car moving equipment. The entire operation will be handled by electrically-controlled, automatic equipment.

"We know that the changes being made, while calling for a large expenditure under present conditions, will result in a reduction of fully one-third in our costs of operation at that point, and we expect to do even better than that."

Concrete Paving Awards Still Above Last Year

Concrete highway paving awards continue to run ahead of last year despite a decrease in awards for October, 1931, as compared with October last year, according to the Portland Cement Assn. For first ten months of 1931 concrete highway awards totaled 104,079,287 sq. yd. against 98,159,083 sq. yd. in like 1930 period.

While concrete road awards in first ten months of 1931 are more than in any like previous period, the substantial decline in municipal street and alley paving this year has resulted in smaller aggregate volume of concrete paving awards in first ten months than in any similar period in the past three years. Total highway, street and alley awards for first ten months amounted to 124,763,442 sq. yd. against 130,904,210 sq. yd. in the like period year ago.

Highway, street and alley awards during October totaled 4,008,957 sq. yd. as compared with 8,702,185 sq. yd. in September, and 7,670,613 sq. yd. in October, last year.

Asks Damages of Cement Co. for Deaths from Gas

Explosion of 15,000 lb. of gelatine dynamite by the North American Cement Co. killed two men on April 30, 1930, it is charged in a $50,000 negligence suit against the cement company. The action was brought by Mrs. Martha E. Wallis, widow of Owen R. Wallis, one of the victims, in the Schenectady, N. Y. supreme court.

The defense entered a general denial to the charge, contending that the blast, which had been performed in a lawful and proper manner, could not have caused the two deaths. They contend that gases of the type that killed the two men are frequently found in caverns.

Port Inland Closes as 92nd Cargo Is Shipped

Operations at the Inland Lime & Stone Co. quarries at Port Inland, Mich., have closed for the season after near-capacity output during the summer months. Ninety-two vessels were loaded with stone during the season, a large portion going to the plants of the Inland Steel Co. at South Chicago, Ill. The stone company is a subsidiary of Inland Steel.

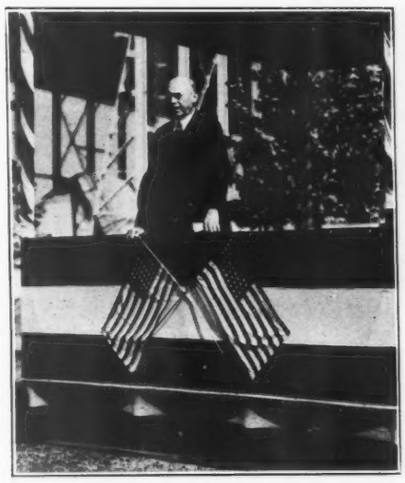
Alabama Cement Mill Gets Safety Trophy

CEREMONIES MARK OCCASION

The Phoenixville, Ala., plant of the Alpha Portland Cement Co., was the scene of an interesting ceremony on November 14 when the safety trophy, won by the plant for having no lost-time accidents in 1930, was presented by the Portland Cement Assn. with appropriate dedication ceremonies.

G. S. Brown, president of the company, accompanied by F. G. McKelvey, vice-president, came to Birmingham for the occasion. Both spoke highly of the record shown by the Phoenixville plant during the dedicatory exercises. Seven of the ten Alpha plants had perfect records last year.

Mark Small, Birmingham district engineer of the association, presented



G. S. Brown making address at the Phoenixville trophy dedication.

the trophy which was unveiled by Misses Carlyn Breaux and Marjorie Brown, small daughters of employees in the plant. G. D. Youell, general foreman, delivered the acceptance speech in behalf of the employees.

President Brown spoke of the industry, its relationship to its employees, stressing particularly the gratification felt by the officials in the achievement accomplished by these workers. H. O. Underhill, Southern manager, was master of ceremonies.

Obtains Injunction to Halt Removal of Gravel

When leasing land for the purpose of utilizing gravel deposits as a supply base, sale of the land may abrogate the rights of the lessee. Franklin County, Iowa, found that out when W. Baurer secured an injunction restraining the county from taking gravel from a pit which he had purchased with land from Ed A. Hicks. Mr. Hicks had leased the pit to the county for a 10-yr. period but in the sale of the land had given the purchaser a clear title and not subject to gravel-lease rights.

Editorials

The Law of Supply and Demand

WHENEVER anyone ventures to speak on the subject of price stabilization he is met with a scornful silence or a torrent of abuse which indicates an underlying worship of the so-called "law of supply and demand." The general attitude seems to be that here is a law, inexorable in its working and cruel in its demands, from the operation and disastrous effects of which there is no relief. Few people seem to be interested in the facts surrounding the discovery of this "law" or in the question of whether or not it is in reality a law from which there is no escape. If demand rises, so do prices until the supply exceeds the demand. If demand falls, so do prices until the supply falls short of the demand. That is economic law, we are told, and it is useless to try to soften its harsh effects.

No one, not even the most casual observer, can deny that the conditions set down above as expressive of the "law of supply and demand" do come about in the manner described, provided no attempt is made to mitigate or prevent the results depicted. But in the qualifying phrase just stated lies the limitations to the operation of the law and it is in fixing those limitations that man has his opportunity to free himself from what too many think are the inevitable consequences of that law.

If, for example, the supply of nonmetallic minerals produced in any given period should exceed the demand for them, then, according to the terms of the law of supply and demand, the price would necessarily fall. Every producer of nonmetallic minerals, in his endeavor to sell what the market seemed not to want, would reduce his price to whatever point he might think necessary to attract buyers, and his competitors, not to be outdone, would lower their prices to points below his. Then each one, more concerned about what his competitor might do than about the state of demand, would make his competitor the point of his attack and a price war would result.

No business man who has survived the trials of the last two years can fail to recognize familiar conditions in this hypothetical case, but he is almost certain to feel that the situation, with all its evils, is beyond his power to control. He knows that the reverse of the conditions described would produce the opposite results and that, instead of a competition among producers to depress prices, there would be competition between buyers to increase prices. He sees clearly the advantages of the latter situation and would gladly do everything possible to create and perpetuate it, but, as an individualist who strongly contends for recognition of his right to conduct his own business as he sees fit, he finds it almost impossible to subscribe to any remedy which requires concerted action and the subordination of temporary private advantages to the general good.

What too many business men fail to see—or, seeing, fail to act upon—is the truth that the most certain way of perpetuating a situation in which the sellers make their own terms is to prevent the development of a situation in which the buyers make the terms. They seem not to realize that to keep prices up one must refuse to let them be pushed down. If this "law" is truly inexorable when it declares that supply in excess of demand depresses prices, obviously the remedy lies in preventing an excess of supply. If business men, realizing this, object that they are powerless to effect that end acting as individuals, the answer is that they must act in concert; and if they object further that such concerted action is illegal to the extent that it violates the anti-trust laws by restraining competition, the answer is that such laws must be changed.

Yet, it is not necessary to change our anti-trust laws in order to accomplish the ends sought; it will be sufficient if enough men practice individually what their judgment dictates. That they do not sustain prices individually is better proof of their fear and mistrust of their competitors than of the unsoundness of the claim that price stabilization is in their own hands. They still do not realize that it is wise to suffer a temporary loss in order to obtain a permanent gain, to waive the smaller advantage in favor of the greater.

Certainly there is no more important form of business education than this—no more important form of trade-association work. If business men are to profit from intelligent control of the law of supply and demand, they must be shown the reason in it, the gains to be derived from it, before they are compelled to subscribe to it, and any legislation which seeks to regulate business—even if that regulation should be designed to help business in prac-

CEMENT-PLANT executive personnel will find this issue of PIT AND QUARRY particularly valuable. Technical men will want to read "A Theory Regarding the Silicates in the Chemistry of Cement Formation," page 57; "Is the Recovery of Carbon Dioxide from Rotary Cement Kilns Feasible?" page 28; and "A Study of the Factors Which Determine the Maximum Lime in Cement Clinker," page 49.

Safety directors, foremen, and members of plant safety committees will find much of interest in "The Relation of Labor Turnover to the Cement-Mill Accident Curve," page 68; and "Making the New Employee a Safe Worker Is the Foreman's Obligation," page 55.

Operating men in general should read "Quarrying Methods and Cost at Trinity Portland Cement Co., Fort Worth," page 43; and "Pack-House Facilities Aid in Economical Distribution of Cement," page 37.

tical ways—would be met with the same evasiveness, the same underhanded circumvention, that is shown by men in their attitude toward other legislation for which no logical foundation has been laid. Except when they act under the influence of fear or sudden emotion men are reasoning and reasonable beings from whom reasonable proposals will receive sensible consideration within the limits of their knowledge and experience. Such being the case, we believe that more is to be expected from intelligent persuasion than from blind compulsion. If business men become educated to the advantages of price stabilization accomplished through production control or other voluntary regulation, legislation designed to accomplish those ends will win general acceptance and support. It may, indeed, even be unnecessary, since it is not ordinarily necessary to compel men to do what they are willing to do.

The enlightened self-interest of every business man will show him the advisability—perhaps we should say the necessity—of selling his product at a reasonable profit but to many men this enlightened self-interest has not yet been demonstrated. And for this he is not entirely to be blamed. If it is quite natural to see the advantage of the moment and to overlook that of the future, it is even more natural to magnify the former and to minify the latter. Only reasonable conclusions, arrived at through reflection or the influence of outside intelligence, can give risks and future gains anything approaching their true proportions. In our opinion, trade organizations in every line of industry share the responsibility for bringing about that state of enlightened self-interest among business men which will recognize the futility and the damage of trying to survive or to weaken competition by the practice of selling their products at little or no profit. On them falls in part, too, the duty of giving intending newcomers in the field an accurate picture of competitive conditions, with respect to production, prices and consuming power, for the purpose of discouraging unnecessary expansion of existing production facilities of their industries and of conserving the investments of those who have brought them to their present state of development.

But, to be effective, this form of educational work must be practical in nature. It must not attempt to base its arguments on ethical reasons, such as one's love for his neighbor or his desire to promote the general good. Not because men are insensible to such appeals but, rather, because appeals to their self-interest will bring permanent results more quickly. Price competition brings damage and, often, destruction, not to the one at whom its acts are aimed, but to the one who practices price-cutting and carries it to its usual lengths. Let that truth be demonstrated, either by individual experience or by logical exposition, and there will be no need for legislation to protect business men's self-interests.

Railways Versus Motors

AS was to be expected, the railroads are still active in their demands for regulation of highway transport and, since the denial of their plea for a 15-per cent. increase in freight rates appeared quite certain, their cry for relief has been louder and more sustained than before. No one requires any special acuteness to see that what the railroads want is not reasonable taxation and reasonable regulation of motor traffic—since these are in effect in many states—but that kind of control which will eliminate motor carriers as competitors. It is because the attitude of the railroads has displayed and continues to display this poorly-disguised objective that shippers in every line of industry—those in our industries more than those in some others—are deeply concerned about attempts to raise the cost of highway transport.

The railroads realize that motor-carrier regulation, in order to be of value from their point of view, must raise motor-carrier rates to points as high as, or higher than, those of the railroads. They realize, too, that the only way in which this can be done is to show that existing motor-carrier rates are below the inclusive cost of maintaining motor service and that, to demonstrate this, it is necessary to inflate the costs of such service by imposing what amount to confiscatory taxes. They realize, likewise, that it will not be sufficient for their purposes to raise motor-carrier rates to the level of railroad rates, because the railroads do not render the shipper-to-consignee service given by the motors, so motor-carrier rates must be raised to or above the point represented by railroad rates plus the cost of cartage from shipper to railroad and from railroad to consignee.

The railroads have recently conceded the point, as stated by Alfred P. Thom, general counsel of the Association of Railway Executives, before the Interstate Commerce Commission, that they do not "at this time recommend that it [regulation] be applied to owner-operated trucks operated solely in the business of the owner." In this way they seek to win the good-will of shippers while appearing to make an important concession but one to which the railroads attach little value. Yet, we believe that, in this, the railroads overlook an important point—although the words "at this time" reserve to them the right of changing their minds—for, if the rates of motor carriers become excessive through over-regulation, shippers will themselves operate motor trucks and, by so doing, escape the penalties of using motor carriers while enjoying the advantages of motor haulage.

In their attitude toward motor traffic the railroads have adopted the plea of the "hard loser." They had many opportunities, before motor traffic reached its present proportions, to make public motor transport, both passenger and freight, a function of railroad service. They could have purchased equipment on easy terms, they could have applied to its use all the experience derived from many years' training in transportation work, and they could have obtained and exercised over it the same degree of monopoly which they exercise in railroad traffic. But, either because they underestimated the capacity of the motor vehicle or because they con-

sidered their own position too secure, they neglected an opportunity and, from one point of view, shirked a responsibility, when they allowed motor transportation for hire escape them. The opportunity they refused was seized by others and, although the traffic has often been mishandled, the economies have been so great that the costs of inexperience and even mismanagement have been absorbed in rate schedules that have been as low as, or considerably lower than, those of the railroads. Now, after motor traffic has developed to sizeable proportions—although Interstate Commerce Commission estimates show that less than three per cent. of the country's available freight is handled by motor trucks—the railroads ask that it be stifled, that industry pay the higher cost of railroad transport in order to keep the railroads on a secure footing.

If motor competition is as small as the Interstate Commerce Commission's estimates would seem to indicate, the railroads have no reason to complain, but the fact that they protest loudly and in some cases effectively against it shows only too clearly that it has made serious inroads in their freight revenues. The statistics presented by the National Sand & Gravel Association at the recent freight-rate hearings showed a material diversion of freight from the railroads to motor trucks and, if many other industries have had similar experiences with motor haulage, the aggregate loss to the railroads caused by the expansion of motor transport must be tremendous. We think the cry of the railroads a better indication of the damage which they have felt and expect to feel than the estimates of the commission, which, while it has access to traffic data for the railroads, has no similar check on motor traffic.

Motor competition has had many wholesome effects on the attitude of the railroads toward shippers. When the railroads offered the only dependable means of intercity transport, they were quite indifferent to the needs of shippers, as evidenced by their lack of interest in installing sidings, their delay in handling shipments, and the like. Since motor competition has become formidable their attitude has completely changed. From the "public be damned" policy of Vanderbilt, they have turned to the position of conciliators and, in the matter of controlling motor traffic, to the position of petitioners. So, apart from its savings to shippers who use it, the motor vehicle has brought the advantages of a more considerate attitude on the part of the railroads and this, in the opinion of those who dealt with and knew the railroads in the pre-motor days, is no inconsiderable gain. Taken in the aggregate, the profits of motor haulage to American shippers have been enormous and should induce shippers to make a thorough study of motor-traffic regulation before lending support to the railroads' plea for competition-destroying taxation.

European Cement Production Equals That of U. S.; Exports Higher

Omitting the production of the U. S. S. R., estimated at 2,000,000 metric tons per year, the cement production of America equals that of all Europe. The figures in each case are around 31,000,000 metric tons. In spite of this situation, Central and South America are buying European export cement, which, to no small extent, has replaced that formerly bought in the United States.

A survey of the Economic Section of the League of Nations presents these figures, and others referring to eighty lines of commodities which largely enter into the economic life of today.

Geographically, cement has somewhat changed its base in these post-war times. Above all, due to cartels and combinations, export business has changed hands and, incidentally, greatly to the disadvantage of United States producers.

Six European countries, with Belgium and Germany at the head, supply the bulk of the world's export cement. Interior consumption is greatest in the United States. Germany, France, Great Britain, Japan, Italy and Canada in the order named.

France, because of the great use of cement in the rebuilding of the war-scarred, northern and eastern provinces, has seen its output increase from 2,518,000 tons to 4,240,000 tons in five years.

Germany, however, due to her widespread policies of public improvements on a scale unknown previous to the war, has more than doubled production, which now stands at 7,039,000 metric tons. This is the highest production of any country of Europe—Great Britain standing second in rank with 4,766,000 tons, and Italy third with 3,497,000 tons. Belgium's figures have increased from 2,000,000 tons to 3,000,000 tons in the last 5-yr. period.

Last year's production shows a slight falling off with respect to Poland (100,000 tons), Esthonia, Hungary and Roumania.

The chief post-war development has been in what European economists refer to as "overseas" countries. Tabulated as to their rate of progression the situation suggests the future growth, even more rapid, of local production, and less and less long-distance export of this heavy cargo.

	5-Yr. Growth *(metric tons)*	
	From:	To:
Africa—		
Algeria	40,000	52,000
Belgian Congo	12,000	160,000
Egypt	85,000	180,000
Morocco	20,000	43,000
Central America—		
Mexico	104,000	225,000
South America—		
Argentina	133,000	233,000
Brazil	17,000	170,000
Chile	96,000	143,000
Peru	11,000	48,000
Asia—		
British India	200,000	341,000
Indo-China	124,000	184,000
Japan	1,884,000	3,700,000
Other countries	700,000	1,165,000
Oceania—		
Australia	482,000	720,000
New Zealand	48,000	220,000

Fig. 1. An airplane view of Plant No. 2, Duquesne Slag Products Co.

Slag Producer's Problems Unlike Those of Other Aggregates Plants

Pioneer Finds 26 Years in Industry Has Been a Period of Continual Development

By C. CALVIN BURGESS
Oper. Mgr. and Consulting Engr., Duquesne Slag Products Co.

IN the production of mineral aggregates for use in concrete, road building, as railroad ballast, and for other purposes, the requirements of the specifications applied—as to cleanliness, exactness in sizing, exact grading of the materials from small to large, exclusion of foreign materials, soundness, durability and general service qualities—have become more and more exacting and precise. A large percentage of the limitations and requirements in the way of producing materials perfectly adapted to the purposes intended have been worked out and put into specification form by the technical societies and engineering departments during the last comparatively few years. This is largely due to the increased attention given to research and to the advance in the art and knowledge of how to produce quality results in concrete and in other forms of construction material.

Along with the other mineral-aggregate producers, the producers of blast-furnace slag have been forced to make rapid progress in the last ten years or less in the methods of preparation and in the equipment required to meet these new and exacting requirements applying to their products. For one illustration, it could scarcely be questioned that the screening capacity in the slag plants, per ton of output, has been increased to 300 per cent. of what would have been considered sufficient twenty-five years ago, or, in other words, at the time when the slag industry was new as an industry producing a product in quantity. It was, of course, true that blast-furnace slag had been used here and there in small ways for at least a generation prior to that time.

Among the pioneer companies developing the use and production of blast-furnace slag in quantity for use as a mineral aggregate was the Duquesne Slag Products Co. Its first plant at Duquesne, Pa., near Pittsburgh, was built in 1905. Without previous experience of its own in this line, the design of the plant was practically just a copy of the standard plants then in use for crushing and screening stone.

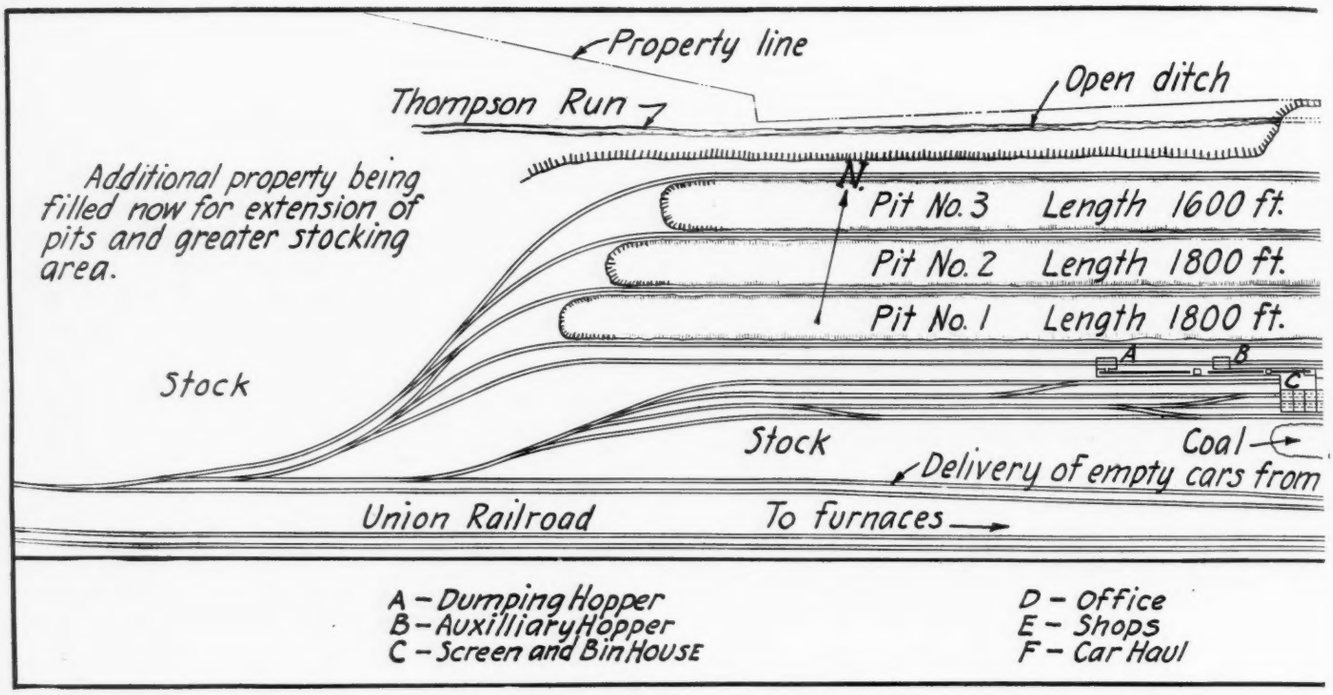


Fig. 2. Lay-out of the Duquesne Slag Products Co. operations, showing the track system,

Experience promptly proved that this design was inadequate in several ways. In less than a year a second or twin plant was built, much the same in type but improved both in roominess and screening capacity as compared with the first. Experience proved that, of all the equipment in use, the crusher was the only part that could be relied on to put through the tonnage of product expected in advance. The screens were not adequate either as to the quantity of material passing or as to performance, so that such improvements, here and there, as could be introduced in a plant already complete were continually added. Even with these improvements the resulting product was so poorly prepared that, measured by to-day's standards, most of it would be rejected.

In 1918, after twelve years of experience with its own plant at Duquesne and several other plants that it had built in the meantime and the study of plants built by various other companies, the Duquesne Slag Products Co. built the present plant, known as Duquesne No. 2, though located several miles inland from the original plant. Based on the knowledge of requirements at that time, the plant was considered one of the best-equipped and, incidentally, as the one of largest capacity in the United

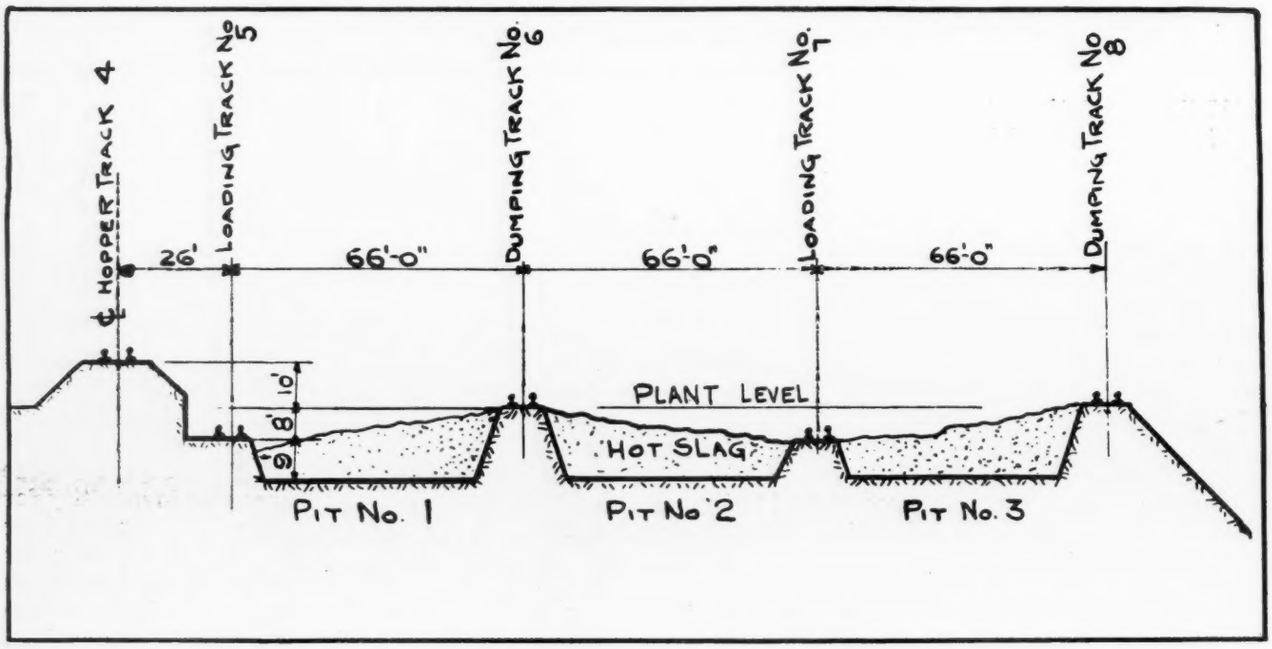
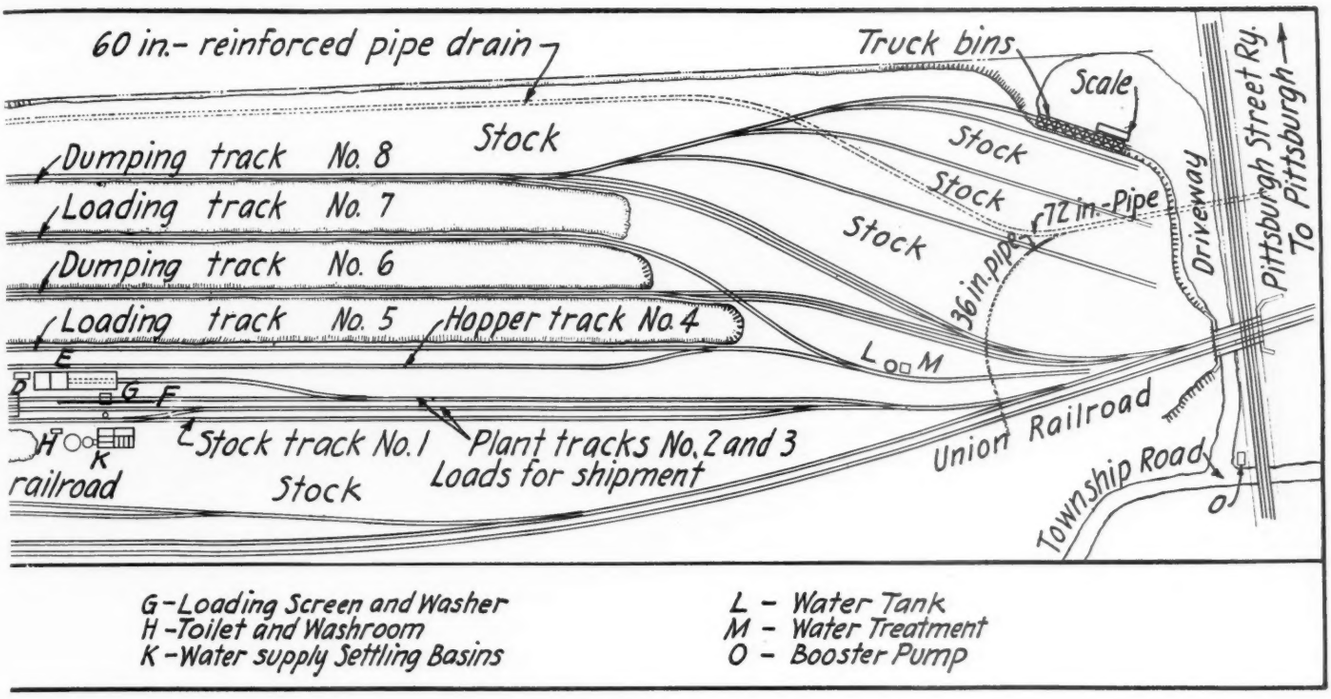


Fig. 3. Section through the slag-cooling pits.



loading and unloading, cooling pits, position of buildings and stock-piles.

States. Year after year since that time changes have been made, new types of screening installed, additions to the crushing and other facilities provided, which greatly increased the efficiency of the plant as well as its capacity for turning out a thoroughly-prepared product.

Along with the other slag producers, the Duquesne company has been a continuous member and supporter of the National Slag Assn. from the date of its organization. This association's efforts and facilities have been devoted exclusively to assembling facts and proofs as to the valuable qualities of blast-furnace slag and as to the necessary requirements in the preparation of this product to adapt it to its proper uses and to meet the demands of the specification writers and construction engineers. The Duquesne company for many years—in common with some of the other producing members of the association—has also been developing a research department of its own, under which there is an organization for testing and inspecting the product to make sure that all material shipped shall be up to the requirements of the specifications applying. The research department, of course, works continually to determine ways of improving the product and discovering new uses for it.

The slag used to supply the plant is produced by the furnaces of the Carnegie Steel Co. located on the Union Railroad at Rankin, Braddock, and Duquesne, Pa. The molten slag from these furnaces is collected in large ladles mounted on railroad trucks and hauled by the Union Railroad to the property of the Duquesne company. Each ladle train consists of from 8 to 14 ladles, which were made by the Wm. B. Pollock Co. Each train, therefore, delivers from 140 to 250 tons of slag. The succession of

Fig. 4. Train of ladle cars on a pouring track. One car is dumping molten slag into one of the cooling pits.

Fig. 5. Shovel loading slag from pit to dump cars.

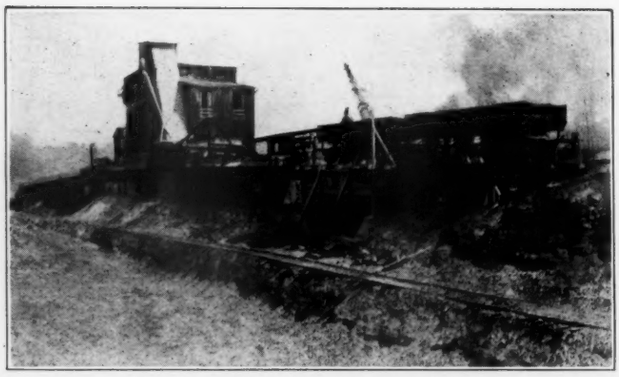


Fig. 6. Hoppers and trestle of track No. 4.

trains arriving within any 24 hr. in normal times deliver an average of 3,000, more or less, of molten slag and over a year supply some excess over the total tons shipped away from the plant. The slag cooling pits now have a capacity of about 150,000 tons. The lengthwise extension of these pits, now being prepared, will double this capacity, so that the steel company can vary the quantity delivered to suit its own convenience or, in other words, provide the year's requirements from the minimum number of furnaces operating continuously.

Fig. 1 gives an aërial view of the plant site, which was constructed on a 65-ft. slag fill. A small drainage stream ran through the property. This drainage was cared for, partially by open trench and partially by a 60-in. precast reinforced-concrete pipe conduit.

Fig. 2 shows a general track lay-out. Tracks 6 and 8 are the dumping tracks for molten slag. Tracks 5 and 7 are for loading slag at the pits. Track 4 is the approach track to the plant hopper and may be used in either direction. Tracks 2 and 3 east of the plant are for the storage of car-loads of finished material ready to be shipped to customers. Other tracks, as shown, are for the receipt of car-loads of raw material that have been dug in other places than in pits, empty cars for loading, for putting material in stock or for reclaiming it from stock, and for delivery service to the truck bins.

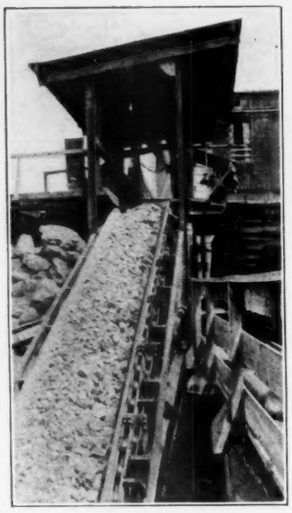


Fig. 8. Conveyor handling slag to the primary crusher.

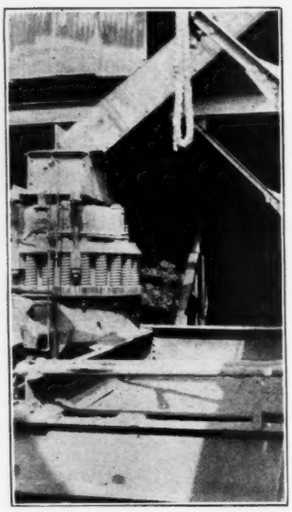


Fig. 9. The 36-in. cone crusher installed above pan-conveyor.

The molten slag from the blast-furnaces enters the property at the east end on Track 6 or Track 8, depending on which pit is to be filled. These tracks are double from the entrance switch to the pit to allow the passing of one train by another and to provide a run-around for the locomotives so, for safety reasons, they can always be on the rear ends

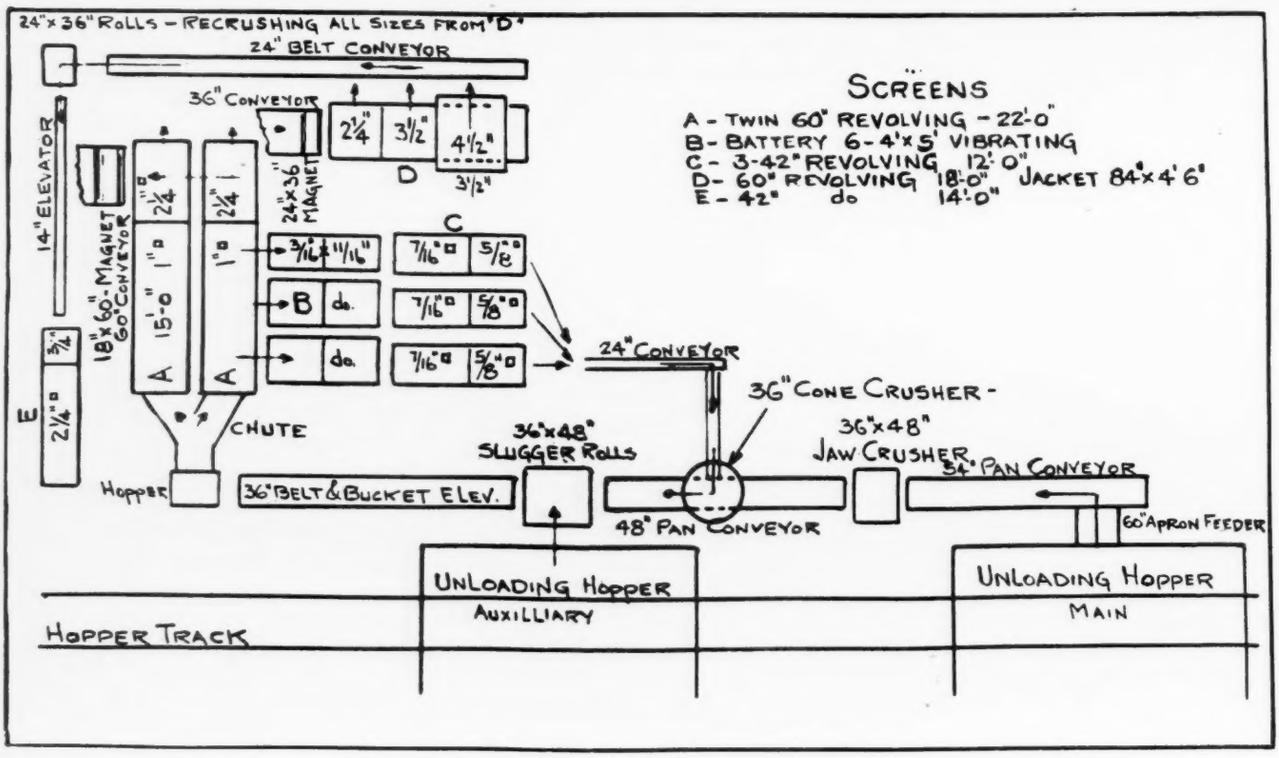


Fig. 7. Flow-sheet of slag-crushing and screening operations.

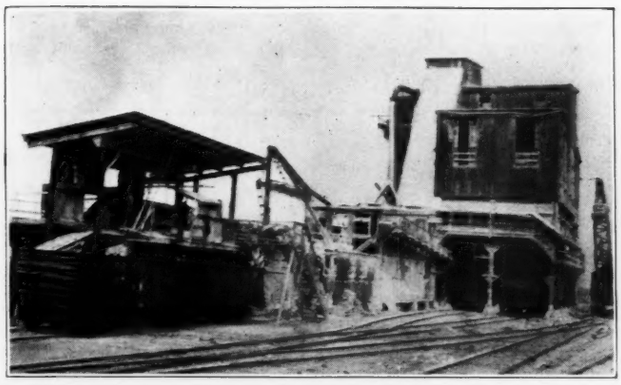


Fig. 10. The plant as seen from the west.

of the trains when these are going out on the pits.

Fig. 3 is a sectional view through the cooling pits and shows the tracks in their relative positions. Fig. 4 shows a ladle train on a pouring track with one ladle pouring molten slag in a pit, and Fig. 5 a steam-shovel digging slag in a pit and loading it in cars that are standing on a loading track. Pits 1, 2 and 3 are poured and dug alternately; while one pit is being poured another is being dug. The steam-shovels—one 70-ton Bucyrus, one 100-ton Bucyrus, and one 100-ton Marion—are of heavy type, mounted on crawlers, and the boilers are fitted with superheaters. The dippers are of 3½-cu. yd.

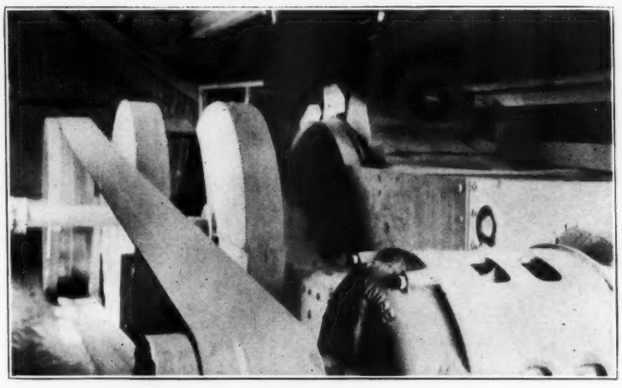


Fig. 11. Head end of elevator showing drive hook-up.

capacity and have four rectangular teeth held in manganese-steel sheaths. The teeth, which were made by the Duquesne company, may be removed and replaced in a moment's time. The locomotives are of standard railroad type weighing 70 to 80 tons each. Thirty-five-cu. yd. air-operated side-dump Western cars are used for transporting slag from the pit to the hopper.

Fig. 6 is a view of the plant hoppers and the trestle of Track No. 4. The trestle is constructed of 40-ft. girder spans supported on concrete piers. The approach to the hopper from either direction is on a grade of 2 per cent. Two side-dump cars just unloaded are standing over the main hopper. An auxiliary hopper is shown five panels to the left of the main hopper. The plant and shop building are in the background. At the extreme left, on Track No. 5, are shown two side-dump cars which are being loaded by a shovel (not shown) from Pit No. 1. The hoppers are of 100-ton capacity each, constructed of steel and concrete, and have a rail

Fig. 12. Revolving screens and chute from the main elevator.

grid to cast off lumps too large for the crushers. The auxiliary hopper is used only when the main hopper is out of service. The main hopper is constructed to care for both side-dump and hopper-type cars. When using hopper cars a counter-balanced lifting leaf is lowered to serve as a working platform for the men.

Fig. 7 is a flow-sheet of the material traveling from the hopper to the storage-bins. The material from the hopper is fed to a 54-in. steel pan-conveyor by an apron-feeder, both made by the Pittsburgh Coal Washer Co. The feeder is driven by a 10-hp. Westinghouse Type CS motor. The conveyor, driven by a 40-hp. Westinghouse Type CW motor, is on an incline of 22 deg. and carries slag to the primary crusher. Fig. 8 shows that the head end of the conveyor is level to serve as a picking table for loose cinder scrap occasionally found in the material. Small pieces are picked by hand, larger ones by electric hoist and trolley. All scrap is placed in a gondola car (shown at the right of Fig. 8) and is returned to the steel mill.

Slag is crushed by the primary crusher—a 36-in. by 48-in. Buchanan machine driven by a 125-hp. G. E. Type KT motor—is passed to a 48-in. Stephens-Adamson pan-conveyor (driven by a 40-hp. Westinghouse Type HF motor), which in turn feeds the material to a 36-in. by 48-in. slugger-roll secondary crusher of Kennedy-Van Saun manufacture. The sluggers on these roll shells are 3-in. square projections which greatly increase the grip of the rolls and tend to crush the material to the desired cubical shape. The projection on one roll

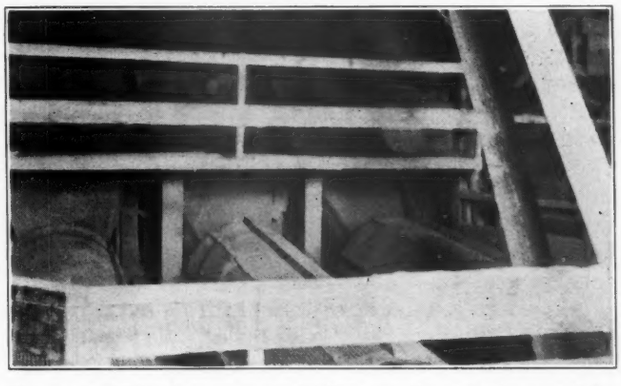


Fig. 13. Vibrating screens feeding to three 42-in. revolving screens.

Fig. 14. Revolving screen which separates large sizes. Magnetic pulley in rear.

Fig. 15. Inclined gravity screen beneath bin for car-loading of slag.

shell fits in between two of those on the other shell. The machine is driven by a 100-hp. Westinghouse Type CW motor. Fig. 9 shows the 36-in. Symons cone crusher installed above the pan-conveyor and driven by a 60-hp. G. E. Type MT motor. This crusher receives material from the storage-bins for recrushing to smaller size. The crushed material passes to the pan-conveyor and thence to the plant.

Fig. 10 shows an end view of the plant looking from the west. The gondola car for receiving picked scrap iron is shown at the left. The conveyor along the lean-to is used for conveying bin material to the cone crusher. The steel derrick and trolley of the lean-to are used for handling cinder scrap when using the auxiliary hopper. The cars under the bins are to be loaded with sized material. The pipes on the building are part of a dust-collecting system which extends throughout the building.

From the secondary crusher the material is delivered by a chute to a 36-in., inclined continuous bucket-elevator and is elevated to the top of the screening plant. The elevator used is 89 ft. long, center to center of the head and tail pulleys, has a speed of 235 ft. per min. and uses 34-in. by 8½-in. steel buckets mounted on an 11-ply elevator belt. Fig. 11 shows the head end of this elevator with its 75-hp. Westinghouse Type CW motor and drive. Material from the elevator is led by a Y-chute to the twin 60-in.-diameter revolving screens (driven by a 50-hp. Westinghouse Type CW motor) shown in Fig. 12. The bottom of the Y-chute is fitted with an adjustable leaf and grid for making run-of-crusher size without using the screens.

All material passing through the first 15 ft. of the twin screens goes to a battery of six 4-ft. by 5-ft. Hum-mer vibrating screens for removing "fines" under ¼-in. diameter and thence to three 42-in. diameter revolving screens to be separated into three sizes (Fig. 13). All material passing through the last section of the twin screens is led to a 60-in. lineshaft-driven belt-conveyor which has an 18-in. by 60-in. Magnetic Mfg. Co. head pulley to remove any remaining cinder scrap. Thence the material goes to the bin. Material rejected by the twin screens passes to a 36-in. lineshaft-driven belt-conveyor having a 24-in. by 36-in. Cutler-Hammer magnetic head pulley for the removal of cinder scrap and thence to a 60-in. Kennedy-Van Saun revolving secondary screen (Fig. 14), where it is separated into three large sizes. The 30-hp. Westinghouse Type CW motor which drives this screen also drives the revolving screens and the belt-conveyors. These three sizes of material are led either direct to bins for shipment or to a 24-in. belt-conveyor which conveys them to a 24-in. by 36-in. Buchanan Type C corrugated shell-roll crusher (driven by a 40-hp. U. S. motor) for recrushing to any smaller size desired. The 24-in. conveyor is driven by a 5-hp. Westinghouse Type CW motor and has a 24-in. by 24-in. Dings magnetic head pulley for protecting the crusher from any stray piece of cinder scrap that may have escaped the other magnets. Material from the 36-in. roll-crusher passes to a 14-in. bucket-elevator (driven by a 5-hp. Westinghouse Type CW motor) and thence to a set of two 4-ft. by 6-ft. Niagara vibrating screens (driven by a 7½-hp. G. E. Type FTR motor) and one 42-in. revolving screen (driven by a 7½-hp. Allis-Chalmers motor) at the top of the plant to be separated into the sizes desired.

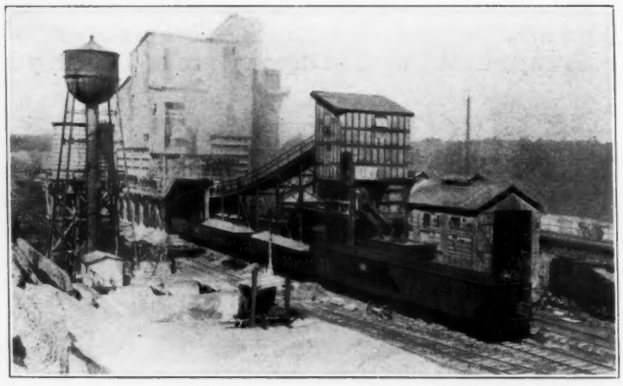


Fig. 16. General view of the plant.

This plant makes eight distinct sizes direct from the screens to the bins, but, to satisfy the trade, many other sizes, which are produced by the combination of any two or more of the eight primary sizes, are required. For this purpose a 36-in. belt-conveyor—driven by a 20-hp. G. E. Type FT motor and fitted with a 24-in. by 36-in. Magnetic Mfg. Co. pulley—has been installed underneath the bins with a chute and controlled gate to each bin, so that material from each bin may be fed to the conveyor in the proportion desired. The material as mixed on this conveyor (Fig. 16), is very well graded as it falls from the head pulley. The head end, as it emerges from under the bins, rises on an incline to accommodate the installation of a vibrating screen in a pent-house where the material may be freed of "fines" or, if necessary, washed. Washing is done by a series of pressure-water jets located above the vibrating screen. The settling and storage tanks for reclaiming all the water possible are shown in Fig. 16.

To avoid the segregation of the sized material as it is delivered from the vibrating screen at the head of the under-bin conveyor to cars, the width of the

stream of slag from this screen is divided into four equal parts and each part is led by a chute, so that material is distributed in four equal portions over the width of the car. This is further increased by cutting the bottom plate of each chute at an angle of 45 deg., thereby approximating a continuous flow of material over the entire width of the car. Longitudinal segregation is prevented by a shuttling movement of the car under these loading chutes produced by a 10-hp. Webster automatic electric car-haul, thereby loading the cars in layers as desired.

For removing excess "fines" from the screened slag when dumped direct from the main bins into the cars, an inclined gravity screen on rails is placed under any gate (see Fig. 15) and material is passed over it. "Fines" that pass through the screen are temporarily held on a plate floor which is later tripped by a foot lever to dump them into the car assigned for that purpose.

Industrial-Brownhoist locomotive cranes with 50-ft. booms place the material in stock and remove it from stock (Fig. 17). Fig. 18 shows a tower screen used for removing "fines" from stock material when loading.

Fig. 19 shows eight bins and scales for the truck delivery of slag. Over 4,000 tons of slag has been loaded on trucks and weighed in 10 hr. from these bins. Each bin has a capacity of 75 tons and is loaded by hopper cars from above.

Office, toilet and washrooms are provided for the men. There are also blacksmith, machine and repair shops for repairing the equipment.

All crushers, screens and large conveyors are operated by individual motors. All slow-speed machines have speed-reducers of proper ratio direct connected and all drives are direct-coupled, rope or belt. The plant and the shops are entirely electric-motored, the power being purchased from a local company which supplies 3-phase, 60-cycle, 2,300-v. current. The power substation is located across the pits from the plant, the 2,300-v. current being brought across the pits by insulated cables on steel towers high enough to clear the 50-ft. booms of the cranes. This current is reduced in the plant to 230 v. by three single-phase 200-kv.-a. transformers. The power-lines are incased in conduit.

Magnetic controllers are used on all the primary circuits of all the motors, except the primary-crusher motor which is equipped with a hand-starting compensator. All the controls are interlocked, from the small sizing screens back to the hopper feeder, so that all the equipment must be started in sequence and, in case of the shut-down of any unit, all the units feeding that unit will automatically stop. This inter-locking, however, is carried around the crushers and is so arranged that these units continue operating, but their feed units are stopped.

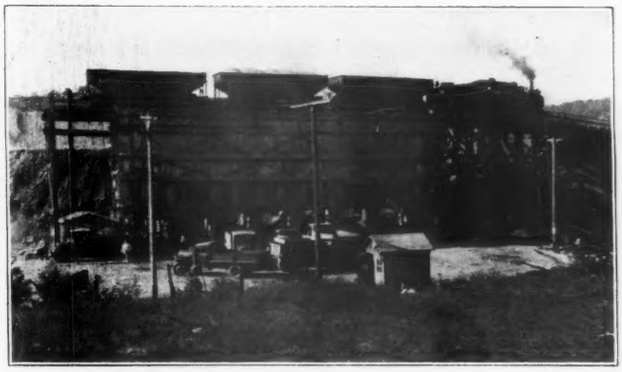


Fig. 19. Bins for loading trucks for local deliveries.

Some synchronous motors are used but, for power correction, a 240-kv.-a., 2,300-v. static condenser has been installed on the ground floor of the shop building where it is free from vibration. The transformers and switch-room are on the second floor of the bin building. A 300-kv.-a. 3-phase transformer steps the 230-v. plant current up to 2,300 v. for the condenser. The oil switch for the condenser is interlocked to the plant-elevator control, so that it is not possible to operate the elevator or the plant unless the condenser switch is closed.

The plant as described has proved a very satisfactory and economical arrangement with many safety-first features as well. Safety is treated as of prime importance, safety meetings being held monthly at each plant. The safety idea is brought prominently to the attention of the men by lectures and posters. All the equipment is properly protected, attention being paid to avoiding injury by falling material. Working conditions for the men are made as safe as possible. The management is at all times open to suggestions. The plant and buildings are also adequately provided with water and apparatus for fighting fire.

At each plant an inspector, equipped with screens, samplers and other equipment, tests all the material as made, both for shipment and stock. A report of these tests is made daily.

All the designing and construction work done in connection with the planning and erection of this plant was executed by the Duquesne company, which built the hoppers and chutes, the bucket-elevators, all the belt-conveyors, some of the revolving screens, the tower screen, and the truck-loading bins.

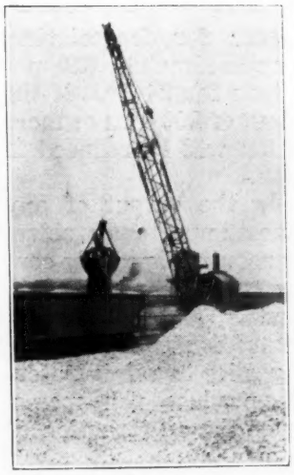


Fig. 17. One of the 50-ft.-boom cranes at the stock-piles.

Fig. 18. Tower screen for removing "fines" before loading.

Is the Recovery of Carbon Dioxide from Rotary Cement Kilns Feasible?

By AMAN MOORE
President, Cement Securities Co., Ltd.

IN previous articles I have stated that the use of rotary cement kilns with a length of 400 or more ft. had three important advantages: (1) Economy in fuel; (2) the production of a quick-hardening Portland cement by one burning only; and (3) reducing stack temperatures of the kiln gases to the minimum and making it possible to recover CO_2 and manufacture gas-ice on a profitable basis. Since one of the main costs in the manufacturing of CO_2 into gas-ice is a matter of securing a low-cost source of CO_2, and since the available supply from rotary cement kilns is probably the largest available supply of any industry in the United States, other than blast-furnaces, and since the cost of recovering the CO_2 as a by-product from rotary cement kilns is largely one of cooling the gases, removing the solids, and then separating the CO_2 gas from other gases and impurities and deodorizing it, it becomes a problem of whether or not this process is practical and sufficiently economical to make available this enormous supply of CO_2, now a waste product, for the successful manufacturing of gas-ice.

A pure lime rock contains 44 per cent. CO_2 and 56 per cent. CaO. The CO_2 is liberated from the lime rock at a temperature of approximately 1,800 deg. F., while the CaO combines with the silica, iron and alumina in forming the hardening compounds in the Portland-cement clinker. The chief obstacle preventing the utilization of this by-product in the past has been the fact that a large number of plants use the dry process, with short kilns and stack temperatures ranging from 1,000 deg. to 1,800 deg. F. Under such conditions the gases are so heavily laden with solids, such as dust and other impurities, that the expense of the equipment and the process for converting the CO_2 into a liquid and then transforming it into a de-odorized solid has been so great that no successful efforts have so far been made in recovering the CO_2 as a by-product, and manufacturing it into a merchantable product of gas-ice at a cost sufficiently low to net a profit above the cost of manufacture.

My contention is that, with modern long kilns, 400 or more ft. in length, the stack temperatures can be brought down to approximately 212 deg. F., or sufficiently low so that with little expense they can be cooled, making it possible to remove the solids, odors and other impurities, convert the CO_2 into a liquid, and then manufacture it into a merchantable product of gas-ice at a cost sufficiently low to enable a good profit to be derived.

The flow-line of the gases is as follows: The gas from the rotary kiln enters the gas-washer or scrubber, whence it passes to the low-stage compressor. Leaving this, it enters the absorber, where it is taken up in the liquor and passes through the heat interchanger and then to the decomposer, meeting in the heat interchanger the return liquor which is on its way back to the absorber. From the decomposer, the gas travels to the condenser. Leaving the condenser, it may go either to the gas holder for storage or directly to the 3-stage compressor, where it is compressed to a pressure of about 1,000 or 1,200 lb. per sq. in.

Leaving the 3-stage compressor, the gas goes to a condenser, where it is liquefied. From the condenser the liquefied gas goes to a precooler before being introduced to the snow-machine. This gas is only partly converted to snow; the unconverted part is brought back and recompressed and used again in the snow-boxes. After the product leaves the snow-boxes, it is wrapped in paper cartons and is then ready for storage or for shipment.

In order to maintain a proper standard of liquor in the absorber, causticizers are provided. These furnish a convenient method of changing the liquor as may be required. The idea is to have one tank full of purified liquor, ready for use, the other tank to take the discharge from the system, where it is causticized and prepared for use as required.

Process steam is required, and steam-boilers suitable for a pressure of from 200 to 350 lb. are desirable. The steam is first used to operate the low-stage gas-compressor. This compressor exhausts against a pressure of about 30 to 35 lb. per sq. in. and the exhaust steam is then used in the decomposers already mentioned. Potassium or sodium solutions may be used for purifying the gas.

With a modern kiln discharging into a cooler, with the cooler sealed to prevent excess air from entering the kiln, the percentage of the CO_2 taken from the kiln gases will be approximately 26.5 per cent. The manufacturing cost of a ton of gas-ice, including a reasonable amount for depreciation, maintenance, etc., will be approximately $10 per ton, based on a unit of 50 tons for 24 hr. If the units are increased to an output of 200 tons or more per day the cost of production will be reduced to possibly as little as $5 per ton.

The question of marketing the output of any given sized unit will be the most important problem to be solved. It necessarily requires specially-constructed trucks for delivery, specially-constructed refrigerator plants for utilization, and, in the event the product can be manufactured sufficiently cheap so that it is possible to use gas-ice in refrigerator-cars for transporting fruits, produce, fish, meats, etc., then it would also require the construction of specially-designed refrigerator cars.

It requires approximately 18,000 lb. of water-ice to transport a car-load of fruit, produce or fish

from the Pacific Coast to the Atlantic Coast, including re-icing eight times between the starting point and the point of delivery. It has been determined that 1,800 lb. of gas-ice will transport, in specially-constructed refrigerator cars, the same products without intermediate icings. It is estimated that the cost of manufacturing water-ice is approximately $2 per ton. If one-tenth of the quantity in weight of gas-ice would transport the same tonnage of fruit, produce, fish or meats, then the transporting company could afford to pay ten times the amount or $20 per ton for gas-ice and would still be far ahead by eliminating all the intermediate icings from the point of loading to the point of delivery on a transcontinental trip.

With an output of approximately 170,000,000 bbl. of cement per annum in the United States, and including the CO_2 created from the fuels consumed in burning the cement clinker as well as the CO_2 recovered from the limestone used in the manufacture of cement, and, provided it were possible to recover all the CO_2, there would be available approximately 25,000,000 tons of gas-ice per annum. Of course, it would be impossible to recover more than 10 per cent. of the total, since most of the plants using short kilns and the dry process would make it uneconomic to recover the CO_2 and manufacture it into gas-ice. Furthermore, the markets would not consume more than a small fraction of the total tonnage of the CO_2 now being liberated and wasted as a by-product from cement kilns.

The possibilities of marketing gas-ice are still problematical. It is useless to speak of gas-ice as "the coming thing," as having "a great future," or "unlimited possibilities," etc. It will require a great deal of effort and perseverance finally to displace water-ice with gas-ice. It will mean a complete revolution of the whole process of refrigeration. It is my prediction, however, that it will not be many years before the ice-man will be delivering a small brick of gas-ice to individual homes and will be placing it in specially-constructed refrigerators instead of the old-style large cakes of water-ice being delivered to the millions of homes where the old-fashioned family refrigerator is in general use.

If gas-ice generally supplants water-ice it will mean the elimination of all forms of small mechanical refrigerators now in use at many family homes, apartments, hotels, etc., throughout the country. When gas-ice is placed in specially-constructed refrigerators, trays filled with water for freezing the small cubes of water-ice can easily be arranged so that the small water-ice cubes for domestic purposes can be secured economically and without the expense of the mechanical refrigerator which requires power to operate and repairs for maintenance. The gas-ice, having a temperature of approximately 110 deg. F., below zero, will quickly freeze the water into water-ice cubes.

Recently there appeared two articles, apparently having one motive in mind, namely, discouraging any efforts on the part of the cement and lime manufacturers to recover the CO_2 and to manufacture it into gas-ice. The first article was written by D. H. Killefer, an official of the Dry Ice Corp. of America. The second article appeared in PIT AND QUARRY, under date of May 6, 1931, by C. L. Jones, vice-president of the Dry Ice Corp. of America. While these articles disclosed clearly the situation in regard to manufacturing, marketing, special equipment for trucks, refrigerators, etc., both articles apparently had the underlying motive of impressing on cement and lime manufacturers that certain important patents were held by the Dry Ice Corp. which would make it difficult for others to operate successfully.

My understanding is that there are no patents whatsoever that will prevent anyone from manufacturing and marketing gas-ice. The term "Dry Ice" is copyrighted and that name can not be used, as it is controlled by copyright and owned by the Dry Ice Corp. of America. There no doubt have been certain patents secured protecting the construction of containers used for the transporting of produce, fruits, or meats. If any patents whatsoever are controlled in such a manner as to prohibit others from operating successfully, then it would be either in the method of construction of refrigerators and equipping of trucks or in the containers used in marketing the gas-ice, rather than in its manufacture.

Since the two articles above mentioned were written by Messrs. Killefer and Jones of the Dry Ice Corp. there appeared in PIT AND QUARRY, issue of May 20, 1931, page 33, an article entitled: "Solid Carbon Di-Oxide-Firm Denied Monopoly; Court Decision Explained." The decision was rendered by the Supreme Court of the United States, Justice Louis J. Brandeis, on March 9, 1931. The case, which had been appealed from a lower court, was entitled "Carbice Corp. of America *v.* American Patents Development Corp *et al.*" The appeal was raised on a writ of certiorari to the Circuit Court of Appeals of the second circuit. The decision denied the right of the owner to restrict unpatented adjuncts. Justice Brandeis, rendering the Supreme Court decision, had the following to say:

"The American Patents Development Corp., as owner of United States Patent No. 1,595,426 and the Dry Ice Corp. as exclusive licensee, brought this suit in the federal court for eastern New York to enjoin contributory infringement by the Carbice Co., for an accounting of profits, and for damages. The defendant denied both the validity of the patent and the alleged infringement. The district court, without passing upon validity, dismissed the bill on the ground that infringement had not been shown. The circuit court of appeals held the patent valid and infringed. A writ of certiorari was granted. . . .

"The patent in suit is not for solid carbon dioxide. That article and its properties as a refrigerant have been long known to the public. The patent is not for a machine for making solid carbon dioxide. Nor is it for a process for making or using that substance. The Patent Office rejected an application for a process patent. The patent is said to be for a manufacture. The specifications outline the method of construction and use; and a typical claim

(6) is for a 'transportation package consisting of a protective casing of insulating material having packed therein a quantity of frozen carbon dioxide in an insulating container and a quantity of freezable product in freezing proximity to said frozen carbon dioxide and the gas evaporated therefrom, arranged so that said frozen carbon dioxide is less accessible for exterior heat than said freezable products.' . . .

"The sole business of the Dry Ice Corp. is the manufacture of solid carbon dioxide, which it sells under the name of 'Dry Ice.' It does not make or sell transportation packages in which solid carbon dioxide is used as a refrigerant. It does not issue to other concerns licenses to make such packages upon payment of a stipulated royalty. . . .

"The Carbice Corp. also manufactures solid carbon dioxide. It is charged with contributory infringement because it sells its product to customers of the Dry Ice Corp. with knowledge that the dioxide is to be used by the purchaser in transportation packages like those described in the patent. The Carbice Corp. challenges the validity of the patent and denies infringement. Whether the transpor tation package described is a patentable invention we need not determine. For, even if it is, no relief can be granted. . . .

"The invention claimed is for a particular kind of package employing solid carbon dioxide in a new combination. If the patent is valid, the owner can, of course, prohibit entirely the manufacture, sale, or use of such packages; or it can grant licenses upon terms consistent with the limited scope of the patent monopoly. It may charge a royalty or license fee, but it may not exact as the condition of a license that unpatented materials used in connection with the invention shall be purchased only from the licensor; and, if it does so, relief against one who supplies such unpatented materials will be denied. The limited monopoly to make, use, and vend an article may not be 'expanded by limitations as to materials and supplies necessary to the operation of it.' . . .

"If a monopoly could be so expanded, the owner of a patent for a product might conceivably monopolize the commerce in a large part of the unpatented materials used in its manufacture. The owner of a patent for a process might secure a partial monopoly on the unpatented materials used in it. The owner of the patent in suit might conceivably secure a limited monopoly for the supply not only for solid carbon dioxide, but also for the ice cream and other foods, as well as of the cartons in which they are shipped. The attempt to limit the license to the use of unpatented materials purchased from the licensor is comparable to the attempt of a patentee to fix the price at which the patented article may be resold.

"The Dry Ice Corp. has no right to be free from competition in the sale of solid carbon dioxide. Control over the supply of such patented material is beyond the scope of the patentee's monopoly; and this limitation, inherent in the patent grant, is not dependent upon the peculiar function or character of the unpatented material or on the way in which it is used. Relief is denied because the Dry Ice Corp. is attempting, without sanction of law, to employ the patent to secure a limited monopoly of unpatented material used in applying the invention. The present attempt is analogous to the use of a patent as an instrument for restraining commerce, which was condemned under the Sherman anti-trust law."

Gas-ice has been known for many years. In fact lectures were given on gas-ice by college professors more than forty years ago. However, the product of CO_2 used in the manufacture of gas-ice on a profitable basis and converting it to a solid form and marketing it as a commercial product has been accomplished only within the past few years.

The following is a quotation from a local trade journal of recent date:

"A fleet of five motor trucks is to be used this season to haul produce from Los Angeles, Cal., to Seattle, Wash., on a schedule of 60 hr. running time. The trucks to be used in this long-distance service are equipped to provide refrigeration with 'dry ice.' It is said that about 75 lb. of this substance under local conditions maintain a temperature below 50 deg. F. for most vegetables. These trucks have a capacity of approximately half that of a standard railroad refrigerator-car."

It will be noted that gas-ice is being used in specially-constructed trucks for delivery of produce and fruits from southern California to the Pacific northwest in competition with railroads using refrigerator-cars cooled by water-ice. If this can be done successfully from southern California to Seattle, it can also be done from southern California to New York and intermediate points. The marketing must necessarily be developed gradually. The outlook for the industry to grow into one of the big industries of the United States and of the world at large is very promising.

There seems to be no serious obstacle in the way of the cement industry's supplying a large portion of the raw product of CO_2 for the successful manufacture of gas-ice on a profitable basis in the very near future. The use of long rotary kilns, 400 ft. or longer, and the wet process of cement manufacture seems to be the most suitable for the utilization of the waste by-product of CO_2 in producing gas-ice on a profitable basis.

ALTHOUGH phosphate rock is Florida's most important nonmetallic mineral, it is by no means the only one of importance in the state. Considerable quantities of limestone and limerock, marble, sand and gravel, kaolin, silica, and fullers' earth are also produced. The wealth of Florida's nonmetallic minerals is described in an article by the state geologist, which begins on page 31 of this issue.

The Nonmetallic-Mineral Resources and Their Development in Florida

By HERMAN GUNTER
State Geologist
Florida Geological Survey
Tallahassee

Singing Tower near Lake Wales, built of coquina, the shell limestone which occurs along the east coast

FLORIDA is a state possessing many natural resources and attractions. Perhaps the one outstanding asset in the list of natural resources is its matchless climate, for this alone attracts annually many thousands of visitors and has caused countless others to become residents. But climate is not the sole inducement Florida has to offer, for in its superb coastline with its unsurpassed beaches, its thousands of lakes dotting the rolling pinelands of the "ridge" section, its marvelous limestone springs some of which are the largest in the United States, its rivers and streams, its hunting and fishing, its woodlands and diversified forest growths, its varied soils producing quality fruits and vegetables for the northern markets during the winter months, its wealth of non-metallic resources, all combine to make of the state one toward which benevolent Nature has been most generous.

Of the natural resources mentioned the mineral resources are perhaps least generally known. These in Florida are confined almost wholly to the nonmetallics and there still exists among many persons a misconception as to what is really meant by the term mineral wealth. It is therefore often concluded erroneously that such states as do not have metallic wealth have no mineral resources. The mining of metalliferous deposits such as iron, gold, silver, copper and lead never fails to arrest public attention because such developments are usually quite spectacular, often yielding large individual profits. It is, however, a matter of common knowledge that, iron alone excepted, the general welfare of the country is far more dependent upon the nonmetallic resources than upon the metallic.

Phosphate

River Pebble.—The term river pebble is applied to phosphates that have accumulated along streams. The best known of these are the deposits on Peace River near Arcadia, De Soto County, and it was here that phosphate mining in Florida began in 1888. Deposits of river-pebble phosphate are known at a number of localities and have been worked at two other points, Alfalfa River in Hillsborough County and Caloosahatchee River in Lee County. Although it was the type of phosphate in which the industry had its inception, the river pebble never figured very largely in the total annual output of the state, but the tonnage increased gradually up to 1893 and then declined until, finally, operations were suspended in 1908. Of the mineral products of Florida phosphate easily holds first place. The phosphates of the state are of different types, known commercially as river pebble, hard rock, land pebble and soft.

Hard Rock.—The hard-rock phosphates were discovered in 1888, and in 1889 operations were begun near Dunnellon, Marion County (Fig. 1). This type of phosphate occurs over a considerable extent of western peninsular Florida, being confined to a rather narrow belt extending southward from southern Suwannee and Columbia Counties for a distance of about 100 mi. to the edge of northern Pasco County, roughly paralleling the present coastline but lying inland some 20 to 40 mi. Less extensive deposits are found outside this quite generally continuous larger area, some of which have been worked commercially.

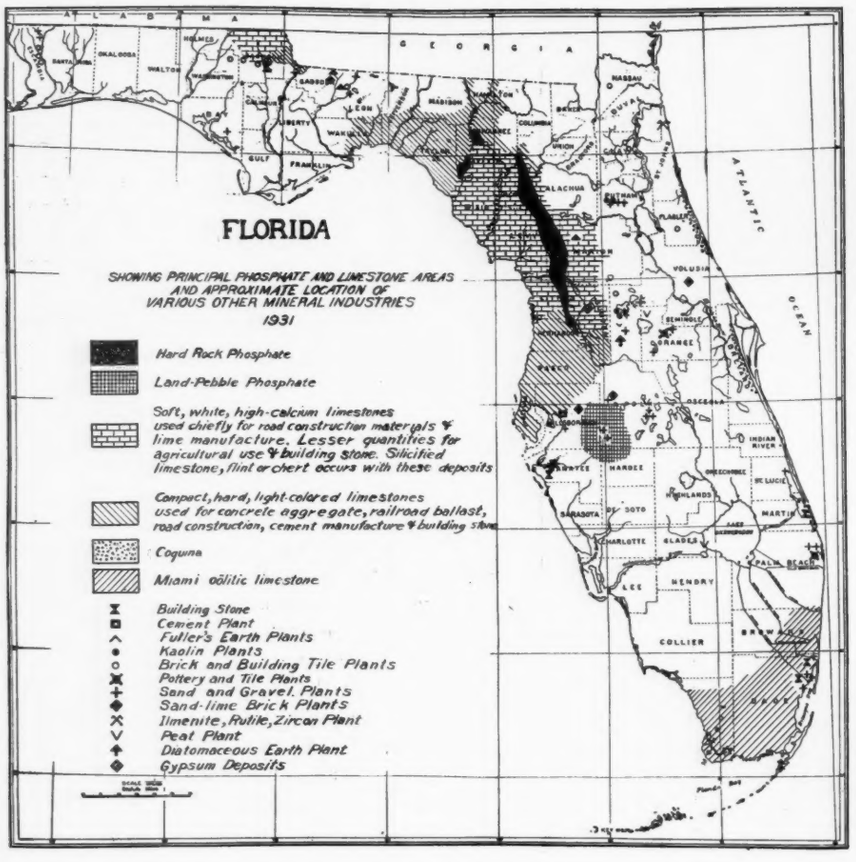
The deposits are underlain by a light-colored, friable limestone of Eocene age. The phosphate formation is made up principally of the residue of pre-existing formations which have disintegrated *in situ*, and consists of boulders and pebbles of phosphate, of various sizes and shapes, embedded in an extremely variable and heterogeneous matrix of light-gray sands, clays, soft phosphate, rock fragments, water-worn flints, siliceous pebbles, and vertebrate and invertebrate fossils. The thickness of the stratum is variable, probably attaining a maximum of 100 ft. in places. The workable deposits of phosphate are not uniform and regular throughout but are "pockety" and irregular, thus

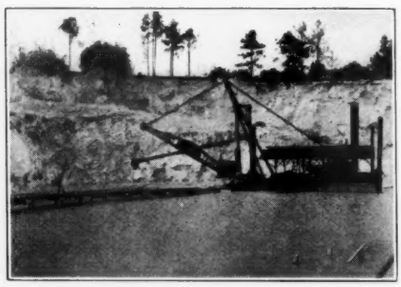
adding greatly to the cost of mining and making it necessary to prospect very thoroughly before establishing a plant.

Land Pebble.—The land-pebble phosphates are the most important of the Florida deposits, the production from this area alone amounting now to about 97 per cent. of the total annual output from the state. The deposits occur principally in southwestern Polk and eastern Hillsborough Counties in west-central peninsular Florida, embracing an area roughly circular in outline about 40 mi. long and 30 mi. wide. Development began in 1890; the first shipment of record was in 1891.

The deposits rest upon a light, cream-colored phosphatic marl or limestone of Miocene age to which the miners have given the appropriate term "bed rock." This bed rock is the formation from which the workable pebble phosphates were largely derived and contains a varying proportion of pebble too low in grade, however, to be of present commercial value. Numbers of fossils have also been obtained from this marl; most common are teeth of the shark, ray, worn pieces of ribs, casts of invertebrates, and silicified corals. The phosphate-bearing formation, termed the Bone Valley Gravel, lies unconformably upon this bed rock. The Bone Valley gravel is made up of rounded and subangular phosphate pebbles varying in color from almost white through shades of brown and gray to black, and in coarseness from fine grains to larger pebbles embedded in a matrix of sand, clay, soft phosphate, flint pebbles and rock fragments. The percentage of phosphate pebble to the whole deposit probably ranges from about 12 or 15 to as much as 50 in restricted areas. In the process of mining are found many marine and land fossils, among which are shark, gavial and other cetaceans, mastodon, camel, horse, rhinoceros and other land animals. Most of these are in fragmentary condition, although numbers of complete teeth and fairly complete jaws and other bones have been recovered. The thickness of the deposit varies from about 5 ft. to perhaps a maximum of 50 ft., the average being considerably less. The phosphate-bearing bed is overlain by unconsolidated sands and clays. Occasionally there is a stratum of iron sandstone which offers some difficulties, particularly when the overburden is removed by the hydraulic method. The overburden varies from a few to 50 or more ft. in exceptional cases. While there are great variations in the thickness of the workable bed, the grade of rock and the continuity of the deposits, there is far more regularity to the land-pebble phosphates than to the hard-rock. The physical character, too, has facilitated more economical methods of development.

Soft.—Soft phosphate makes up quite a proportion of the matrix of the hard-rock deposits and to a less extent the matrix of the land-pebble. While it is most usual to find soft phosphate associated with the deposits of hard-rock or land-pebble, limited isolated pockets have been found not in such relationship. But little attempt has been made to recover the soft phosphate and, consequently, most of it has been lost in the process of mining the other grades. With recent improvements and refinements in the method of mining and recovery more and more of this finely-divided phosphate is being


FLORIDA
SHOWING PRINCIPAL PHOSPHATE AND LIMESTONE AREAS AND APPROXIMATE LOCATION OF VARIOUS OTHER MINERAL INDUSTRIES 1931
Hard Rock Phosphate
Land-Pebble Phosphate
Soft, white, high-calcium limestones used chiefly for road construction materials & lime manufacture. Lesser quantities for agricultural use & building stone. Silicified limestone, flint or chert occurs with these deposits
Compact, hard, light-colored limestones used for concrete aggregate, railroad ballast, road construction, cement manufacture & building stone
Coquina
Miami oölitic limestone
Building Stone
Cement Plant
Fuller's Earth Plants
Kaolin Plants
Brick and Building Tile Plants
Pottery and Tile Plants
Sand and Gravel Plants
Sand-lime Brick Plants
Ilmenite, Rutile, Zircon Plant
Peat Plant
Diatomaceous Earth Plant
Gypsum Deposits
ATLANTIC OCEAN



Above—Fig. 1. Excavating hard-rock phosphate by dipper dredge. Dunnellon, Marion County.

Left—Nonmetallic-minerals map of Florida.

Below—Fig. 2. Hard-rock phosphate washing plant. Felicia Mine, near Felicia, Citrus County.

saved, so that less of it goes to the waste-pond than formerly, and in all probability much of the material that has found its way there in the past will in time be reworked.

Mining Methods.—In mining the deposits of hard rock phosphate the overburden is removed by hydraulic methods. The phosphate-bearing stratum is mined by steam-shovel, or pick and shovel, above ground-water level and by dipper-dredge (Fig. 1) below this level. The material, consisting of phosphate boulders and included matrix, is conveyed by cable-drawn dump cars up an inclined railway to the washer where it is delivered on a steel-rail grizzly with about 2-in. openings (Fig. 2). Here the mass is subjected to washing, all the finer materials passing through the openings, while the oversize boulders are broken by hand or, if necessary, by small charges of dynamite. The rock phosphate and other materials pass through the grizzly into a revolving log-washer where more thorough cleansing is effected and from the logs to long cylindrical screens with different size perforations. The major portion of the clay and sand is removed by these screens and conducted to the waste-pond. The screens are equipped with perforated pipes from which jets of water are ejected, thus more completely removing the clay and sand. The coarser washed rock falls upon a revolving circular table or picker belt, the finer phosphate passing directly to the storage-bin beneath. The coarser rock remains on the slowly moving table, around which a number of men or boys are stationed to remove all the clay balls, limestone fragments or other foreign material before it is automatically scraped off into the bin below. The wet rock is conveyed to a drying shed where, after sufficient artificial drying, it is ready for shipment.

Fig. 3. Drag-line removing overburden from land-pebble deposit. International Agricultural Corp., Mulberry, Polk County.

The overburden of the land-pebble phosphate is removed either by drag-line excavator (Fig. 3), or by hydraulic methods (Fig. 4). Formerly steam-shovels were used at a number of the mines. The phosphate-bearing matrix is removed entirely by hydraulic methods, the material being broken down and washed into a sump hole through ditches by hydraulic monitors operating at a pressure of about 200 lb. per sq. in. From the sump hole the material is picked up by heavy-duty centrifugal sand pumps and conveyed through pipe-line to the washer, where washing, rinsing and screening take place, the cleansed phosphate being elevated to storage-bins and the foreign material passed to the waste-pond. The wet phosphate is transported from the washer to the drying plant by company-owned industrial trains, some of which are electrically-operated, where it is dried in rotary driers using crude oil or coal as fuel. After drying, the rock is carried by bucket-elevator and belt-conveyors to concrete storage-bins awaiting shipment. Considerable research work has been conducted in recent years by the United States Bureau of Mines in coöperation with some of the phosphate companies and other agencies looking toward increased recoveries of phosphate pebble. Among methods experimented with are gravity concentration tabling, and flotation. Promising results have been obtained and some of the recommendations made have been adopted in commercial practice. Independent experimentation has also been carried on in the district with the important result that the International Agricultural Corp. successfully introduced at its plant at Mulberry, Fla. (Fig. 5), in 1930, an oil-flotation process whereby finely-divided phosphate of commercial grade formerly going out with the waste materials is recovered and saved.

Fig. 4. Hydaulicking land-pebble phosphate. American Cyanamid Co., Brewster, Polk County.

Production.—Table I shows the quantity and value of phosphate produced in Florida during 1929 and 1930. A small amount of soft phosphate is included with the figures for land-pebble. The statistics were collected in coöperation with the United States Bureau of Mines.

Limestone, Lime and Crushed Flint

Extensive deposits of limestone occur in Florida and some of these have been developed on a large scale (Fig. 6). Limestone is in fact one of the

Table I.—PRODUCTION OF PHOSPHATE IN FLORIDA, 1929-1930

Variety of Phosphate	1929		1930	
	Long Tons	Value	Long Tons	Value
Land-pebble	3,015,874	$9,633,856	3,166,318	$10,273,076
Hard-rock	72,733	267,218	81,753	517,229
Total	3,088,607	$9,901,074	3,248,071	$10,790,305

state's most abundant minerals. Its chief occurrences are the large deposits of Eocene, lower Oligocene and Miocene age in Jackson County, western Florida, and in Marion and near counties of the

Fig. 5. All-steel washing plant of International Agricultural Corp., Mulberry, Polk County.

peninsular region. There is also a large area of Pleistocene oölitic and coralline limestone in Dade and Monroe Counties of southern Florida and the well-known coquina, or shell limestone, exposed along the east coast (Fig. 7), particularly near St. Augustine and Daytona Beach.

Its first use was mainly for building purposes. The coquina was used for many buildings and structures in Spanish and territorial days and is similarly used at present, and there are numbers of handsome structures in and around Miami made of the local oölite and the coral limestone procured from the keys to the south. A limestone of Miocene age in Manatee County is being quarried for building

Fig. 6. Limestone quarry and plant of Consolidated Rock Products Co., near Brooksville, Hernando County.

stone and is marketed under the trade name "Floridene Stone" (Fig. 8). This stone is increasing in favor and is specified in many buildings being constructed not only in Florida but in other sections of the country as well.

The greater part of the output of limestone is crushed and used in the construction of improved highways and streets. Many miles of surfaced highways of Florida are built of native limestone as a base. Some of the harder varieties are crushed and used as an aggregate in concrete. Considerable quantities are also used for railroad ballast and lesser amounts for direct application to soils or as a fertilizer filler, for which purposes crushing or grinding is necessary.

For almost fifty years lime has been produced in Marion County from the high-grade limestone, termed the Ocala, occurring there. The Florida Lime Co., within the city limits of Ocala, is operating the same pit that was opened in 1884. This limestone is of such purity that it also finds use in the chemical industries.

A more or less silicified limestone, found principally in the western part of peninsular Florida, is marketed as crushed flint and used mostly as material for concrete and railroad ballast. Deposits of similar character are also known in other sections of Florida but have as yet not been commercially developed.

Cement

The production of cement in Florida, which began in 1927 at Tampa on the completion of the plant of the Florida Portland Cement Co. (Fig. 9), has been increasing ever since, and the product is now widely used throughout the state and quantities are also exported. The raw materials are limestone from Hernando County and clay from Hernando

Fig. 7. Exposure of coquina near Matanzas Inlet, Flagler County.

and Citrus Counties. The wet process of manufacture is used and the mill is modern in every respect.

Fuller's Earth

The extensive fuller's earth deposits of Florida are of Miocene age. This earth has been mined in Gadsden County since 1895, and it was here that commercial production in this country began. For many years Florida was the leading producer, but with large developments in southern Georgia the state of Florida in recent years has held second place. Fuller's earth is a variety of clay which has the property or capacity of absorbing basic colors from solution in animal, vegetable or mineral oils, as well as from water and certain other liquids. The Florida earth is used mainly in clarifying mineral oils, although some is used in filtering vege-

table oils and fats. In recent years deposits have been opened in Marion County, central Florida, and these give promise of continued development. All the deposits are mined by the open-pit method, the overburden being removed by steam-shovel and by hydraulicking, the earth being mined by steam-shovel (Fig. 10). The fuller's earth is transported to the mill (Fig. 11) by dummy trains and dumped into large storage-hoppers of special design. From this the earth moves by conveyor-belt through a crusher and on into a long rotary drier using fuel oil. After drying, the earth is ground and sieved or bolted into different commercial sizes, and bagged for shipment.

Clays

The clays of Florida, other than fuller's earth which is of special type, fall into two broad groups: First, the high-grade, white-burning clay or sedimentary kaolin, of Pliocene age, found principally in the northern part of the lake region of central

Fig. 8. Quarrying blocks of "floridene" stone. Florida Travertine Corp., at Bradenton.

peninsular Florida and shipped out of the state as raw clay to the manufacturers of porcelain, china, wall-paper, etc.; and, second, the common clays found in many parts of Florida, particularly the northern and western portions, which generally burn red, and are utilized in the manufacture of brick, building and drain tile, etc.

Kaolin.—The kaolin occurs as a massive deposit of almost white clay-bearing sand, from about 6 to 30 ft. or more in thickness, overlain by soil and vari-colored sandy-clay materials varying from about 6 to 20 ft. This overburden is removed either by steam-shovel or by hydraulicking. After removal, a pit is dug into the kaolin-bearing sand and is made sufficiently large to begin an artificial pond or lake in which is then placed a floating dredge. The kaolin-sand is dug up by dipper-dredge and dropped into a bin from which it is pumped through a pipe to a series of "sand traps" by which process the sand is removed. The clay-bearing water then passes through a series of long troughs having baffles which cause the clay to remain in suspension while the sand and any other impurities of higher specific gravity settle out. From the troughs this clay-bearing water passes to settling vats where, after sufficient time, a quantity of the water is pumped off. The clay sludge is then forced through filter presses, operating under a pressure of about 80 lb. per sq. in., which remove the excess water. The filter cakes of moist clay are placed in either steam or hot-air drying sheds and, after further drying, are ready for shipment. Necessarily some clay remains in the water used in the washing process and that extracted in the filter presses, but all this is conducted back to the pit. Regardless, however, of the care and precautions taken to guard

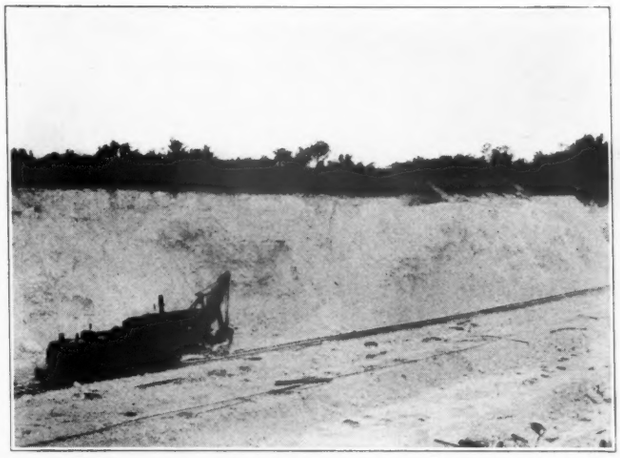


Fig. 9. Quarry of Florida Portland Cement Co. near Brooksville, Hernando County.

against loss, some clay is carried out with waste or by-product sands. These sands are used in construction work generally and it is possible that they would be adapted to other uses.

Recently deposits of kaolin-bearing sands of probable commercial extent have been located in western Florida and these give promise of development.

Common Clays.—The common clays in Florida are not confined to any particular geologic formation but occur from the oldest to the youngest. The clays of the older formations are in large part, if not

Fig. 10. A fullers'-earth pit near Midway, Gadsden County.

entirely, residual in origin. Such clays are common in the limestone sections of the state but frequently may be limited in quantity and irregular in occur-

rence. In the manufacture of brick it is known that some of these clays have developed peculiar properties which have made them rather unsatisfactory for these purposes.

The sedimentary clays of the Citronelle formation, Pliocene, are extensively used in the manufacture of building brick and other clay wares in western Florida. Although common brick is the main manufactured product, it is known that these clays are adapted to the manufacture of stoneware, terra-cotta, tile and pottery. Large brick plants

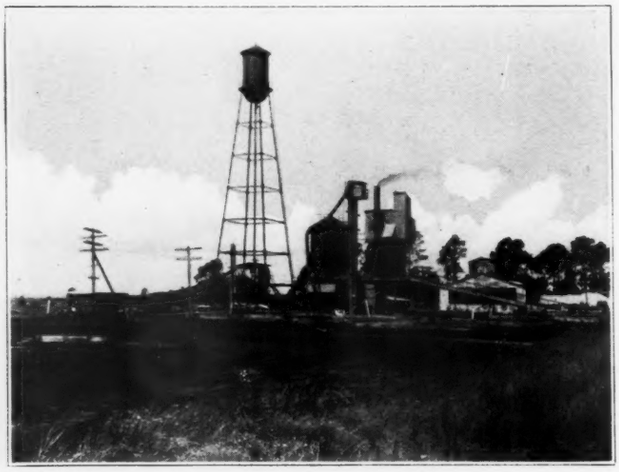


Fig. 12. Peat plant of Florida Humus Co. in Orange County. The peat is dried on a 10-acre area paved in its entirety with concrete.

have been in operation in Escambia County, the westernmost county of Florida, for many years and the brick is of excellent quality.

Of the common clays probably the most extensive are the flood-plain deposits found in the valleys of the larger rivers and streams. This is particularly true of St. John's, St. Mary's, Ocklocknee, Apalachicola, Choctawhatchee, Blackwater and Escambia Rivers. The flood-plain clays have been extensively used in brick manufacture and many deposits of commercial extent may be found along the streams mentioned. In addition, lacustrine clays, some of which have been utilized, are found in different sections of the state. In its clays the State of Florida has a natural resource which has been scarcely touched and which invites development.

Sand and Gravel

Sand abounds in nearly all parts of Florida, but varies greatly in fineness, sharpness and uniformity of grain, so that some deposits are much better adapted for use in mortar and concrete than others. The principal localities of commercial production are associated with formations of Pliocene age in west Florida and the lake region of the Peninsula. Sand-bars along some of the rivers and lake beaches are also important. An excellent grade of sand, very white, with sharp grains, is a by-product from the washing of kaolin previously mentioned. In the southern part of the state some of the so-called sand, dredged from rivers and harbors, contains a large proportion of shell fragments.

The best gravel is dredged from the beds of rivers that have brought it down from the hills farther inland, principally the Apalachicola and the Escambia. Florida is too far from crystalline rocks to have much gravel on uplands, but there is a good deposit of coarse flinty pebbles near Round Lake, Jackson County, western Florida. This deposit of gravelly clay was worked for some time, the material being used in the construction of gravel roads.

Sand-Lime Brick

Sand-lime brick is a manufactured product, made from sand and lime, and for a number of years this kind of building material has been made in Florida. Excellent sands are available in different parts of the state and the lime can also be procured from the manufacturers no great distance away. The price received for the brick compares with that of common clay brick.

Rare Earths

The production of "rare earths," ilmenite, monazite, rutile and zircon, from the beach sands along the east coast in the vicinity of Mineral City about 5 mi. south of Jacksonville Beach, which began in 1916, reached a peak in 1927, then declined, and was discontinued in 1929. The high value of the beaches for resorts and recreational purposes was one reason for the discontinuance. Other deposits of these concentrates, probably of commercial importance, are known, particularly along the Gulf coast of western Florida.

Peat

Peat is widely distributed over the state, but is most abundant in the lake region and the Everglades. The attempt to develop deposits for fuel purposes have so far proved unsuccessful, largely on account of the cheapness of other materials which compete. Its use as a fertilizer filler and for

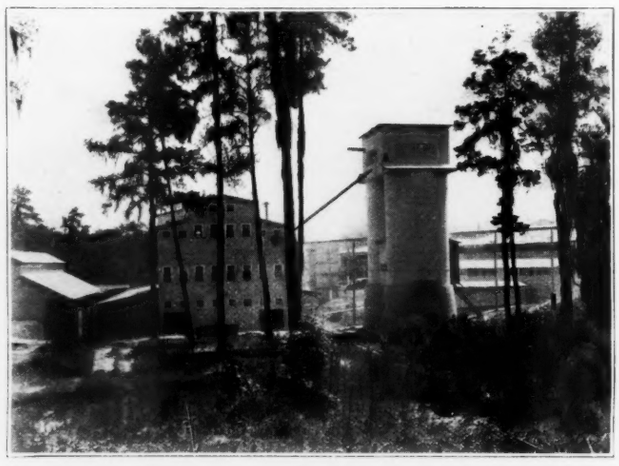
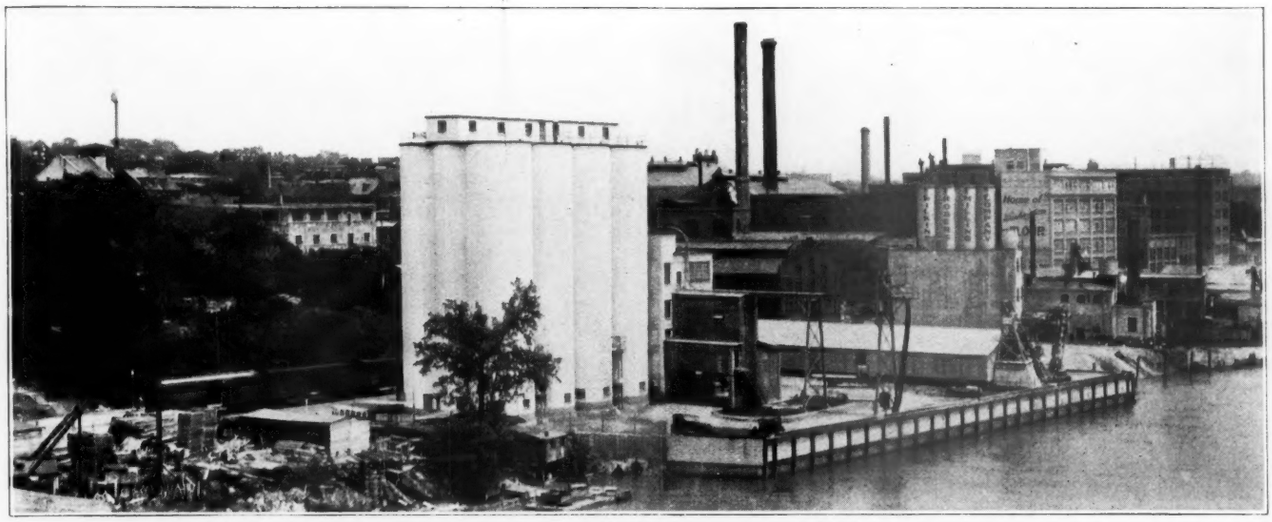


Fig. 11. Fullers'-earth plant of the Floridin Co. at Quincy, Gadsden County

direct application to soils is meeting with favor and there are plants (Fig. 12) located in peninsular Florida which produce it for these purposes.

A product somewhat like peat, in that it contains a percentage of organic matter but in reality is composed mostly of sand, namely hardpan, was mined

(*Continued on page 48*)



The Washington, D. C., pack-house as seen from the Francis Scott Key bridge.

Pack-House Facilities Aid in Economical Distribution of Cement

Washington Unit of Lone Star Cement Co. of Virginia Indicative of Present Trend

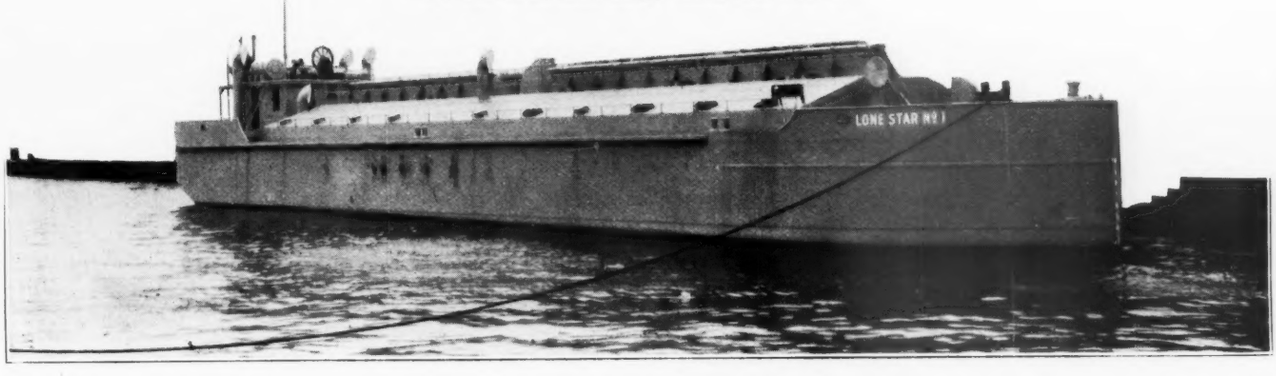
PACK-HOUSES in metropolitan centers have demonstrated their economic worth to the cement industry in all parts of the country. Because of the economies gained through bulk transportation and better service rendered to territory business, pack-houses have become an important factor in cement distribution.

Water-way transportation especially has enhanced the value of pack-house distribution and several leading companies have for some time taken every advantage of this low-cost method of moving large volumes of their product. Specially-designed lake and river carriers have been brought to the attention of the industry within recent times and undoubtedly a good deal of progress is in store in this direction.

One of the best examples of pack-house distribution with water-way transportation is presented by the Lone Star Cement Co. Virginia, Inc., Washington, D. C., pack-house which is operated in conjunction with its mill at Norfolk, Va. As Washington has long been one of its principal markets, the new improvement is a logical one. With the Potomac River and Chesapeake Bay water-way at both cities' doorsteps the use of water transportation was inevitable.

The new pack-house, which was built in 1929, consists of an 8-silo storage plant with bulk car-loading and truck-loading facilities as well as complete packing facilities. It is located on the north bank of Potomac River within the shadow of the new Francis Scott Key bridge which connects Georgetown with Roslyn, Va. This bridge, incidentally, was an important Lone Star contract. Railway service adjoins the pack-house site, the Baltimore & Ohio Railroad providing the company with a 4-car siding. With both water and rail transportation at hand, yet within convenient trucking distance of the entire Washington district, the value of this site as a distribution point is evident.

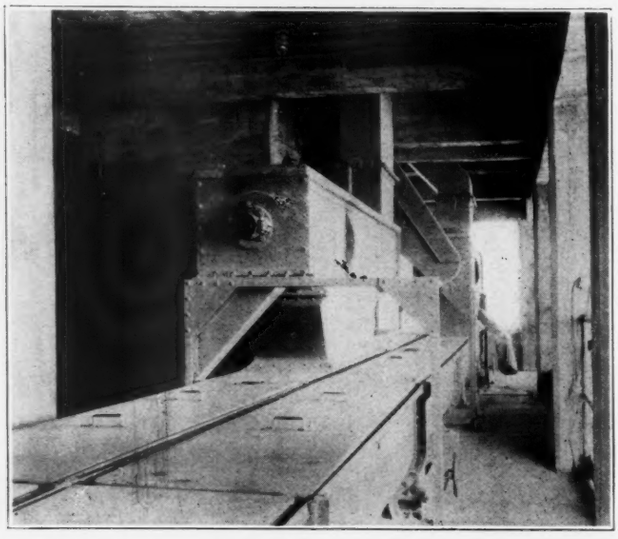
The 163-ft. all-steel barge "Lone Star No. 1."



Conveyor for loading sacked cement from pack-house to barges.

Extension conveyor on barge permits loading to any height.

The site as purchased was unimproved. To meet the company's requirements, a level area was needed for trucking and proper dock facilities for its barge service from Norfolk. Accordingly, contracts were let for the construction of a 250-ft.



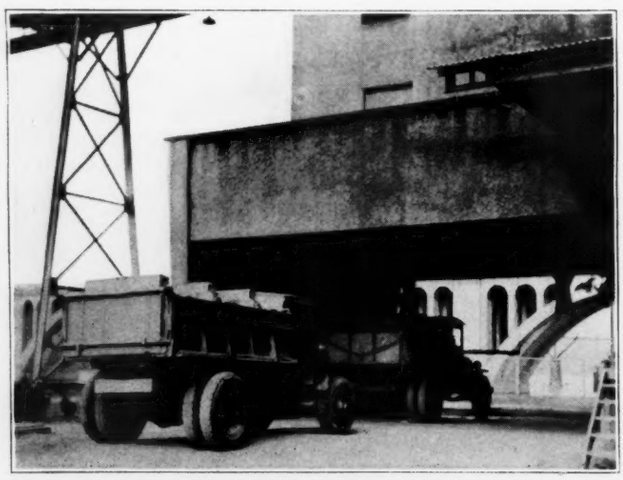
Screw-conveyors which handle the cement received by barges.

concrete-pile dock running the length of the property. This was built with Raymond water-front piling to a height of 15-ft. above the mean tide-water level and is faced and capped with concrete and fronted with timber spiles. It is back-braced every 50 ft., the braces being anchored in concrete. Following the completion of the dock, the entire area was filled with cinders to the level of the adjoining street.

Contracts for the construction of the silo-and-pack-house structure were let to the Rust Engineering Co., based on plans furnished by the Macdonald Engineering Co. The structure is of steel and reinforced-concrete construction and rests on heavy piling. Caissons 40 ft. deep were dug for the foundations, the weight of the structure and its load requiring them because of existing soil conditions.

The silo-storage unit consists of two rows of 4 silos with four interstitial bins, or a total of 12 bins, with a combined storage capacity of 66,000 bbl. Each silo is 20 ft. in diameter and 79 ft. high. Four types of cement are normally stored, these being manufactured to meet Bureau of Standards, commercial, Froehling & Robertson, and standard cement specifications.

For the movement of bulk cement from the mill at Norfolk, to the pack-house at Washington, a specially-designed barge was built by the New York Shipbuilding Corp. The *Lone Star No. 1*, as the barge is named, is in reality a motorless boat but in every respect a seaworthy vessel. It has a steel hull and deck and is 163 ft. long with a 37-ft. 6-in. beam. Its over-all height is 19 ft. Cement is carried in two hoppers running the full length of the hold between the bow and stern compartments. When loaded, the barge carries 5,600 bbl. of cement



Loading bulk cement to motor trucks.

—a normal week's supply for the Washington pack-house. Both hoppers are completely inclosed save for the 20 man-hole ports on the decks. Cement is recovered by a series of screw-conveyors below the hoppers which feed to a Fuller-Kinyon pump. As there is no power source on board, this equipment is inoperative until the barge reaches either

dock, where electric power, compressed-air and other utilities are made available through flexible hoses and cables. The *Lone Star No. 1* has quarters for its captain and his family as well as for 2 helpers.

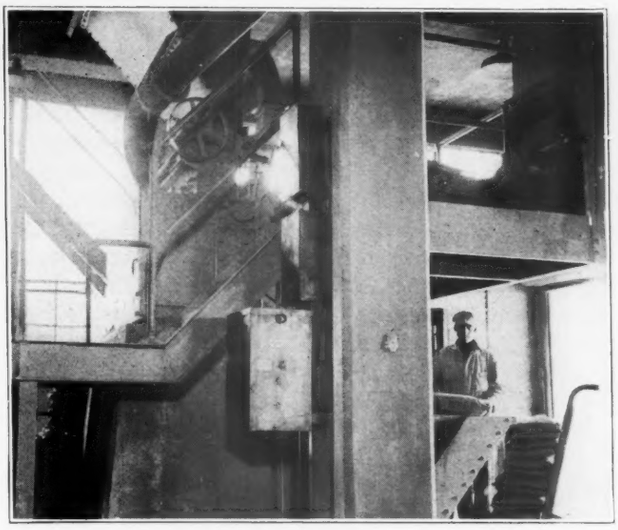
Sufficient storage capacity at the Washington pack-house enables it adequately to serve its territory for long periods of time. During the slack-business seasons the *Lone Star No. 1* is retired, which accounts for the fact that it was built motor-

Loading platform for sacked cement.

less. Carrying no large crew of men, overhead is cut to a minimum when the barge is not in service, and no maintenance or depreciation charges are carried on a machinery investment. In normal service a lighterage company is engaged to tow the barge back and forth between Norfolk and Washington as business needs demand. The 200-mi. distance by water is covered in 40 hr. upstream and 30 hr. downstream.

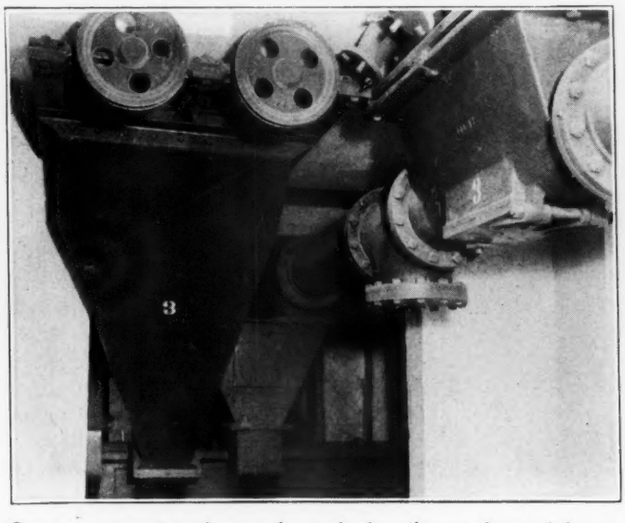
At the Washington dock service utilities for the *Lone Star No. 1* are extended from the pack-house on steel bents to the face of the dock. Through counterweights, the heavy hose and cable connections are given ample length compensation for variations in the tidewater level and the barge's draft from loaded to light. Also, at the dock complete switchboard control is provided for the regulation of all service utilities, including the air-compressor in the pack-house. The latter is an Ingersoll-Rand 2-stage unit driven by a built-in 225-hp. synchronous motor. The compressor is rated at 1,300 cu. ft. of air per min. The cement is pumped direct to any of the 12 bins in the silo system.

Beneath the interstitial bins and extending throughout the length of the structure are two 16-in. screw-conveyors which receive and transport the cement from storage to elevators in the pack-house. Cement from the interstitial bins and the near side of the silo-bins is fed direct to the screws by gravity, the flow being controlled by rack-and-pinion gates. For recovery from the centers and far sides of the silos there are cross screw-conveyors, which discharge to either of the two 16-in. main



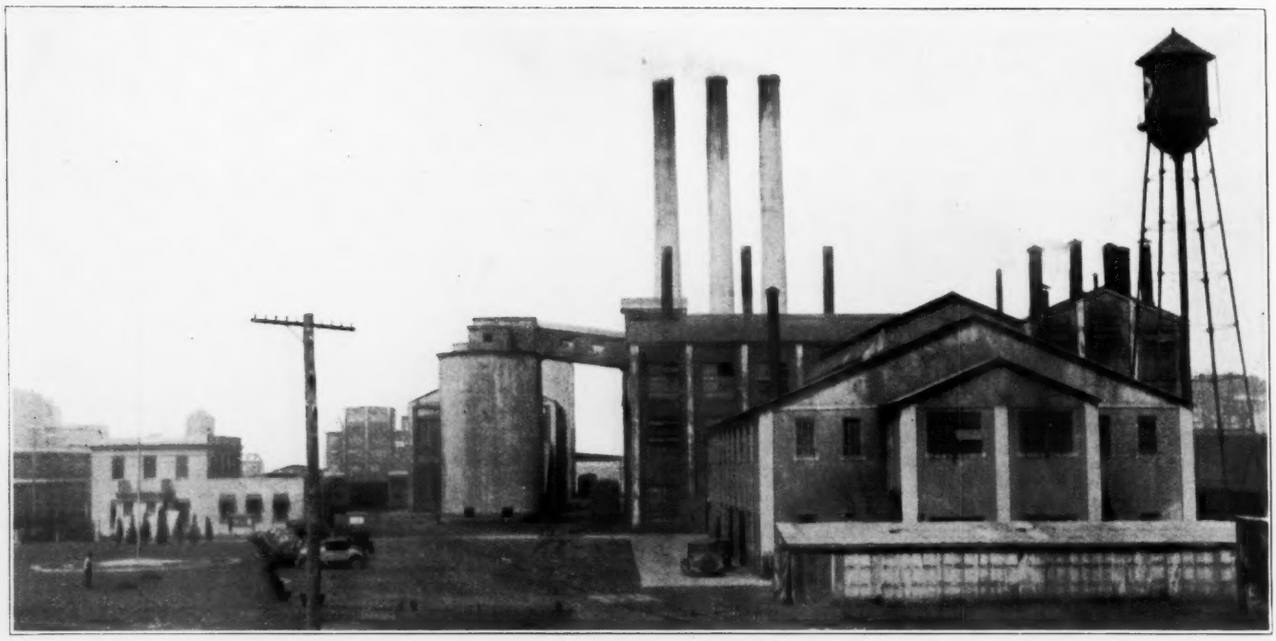
One of the automatic baggers in the pack-house.

screw-conveyors. These units have 9-in. screws and are individually driven by 5-hp. motors through Jones speed-reducers. They are, like the two 16-in. main screws, of Webster & Weller manufacture. Each of the main screws is driven by a 15-hp. motor through a Jones speed-reducer.



Cement-recovery equipment beneath the silos at the pack-house.

Similar equipment in the new storage buildings at Norfolk.



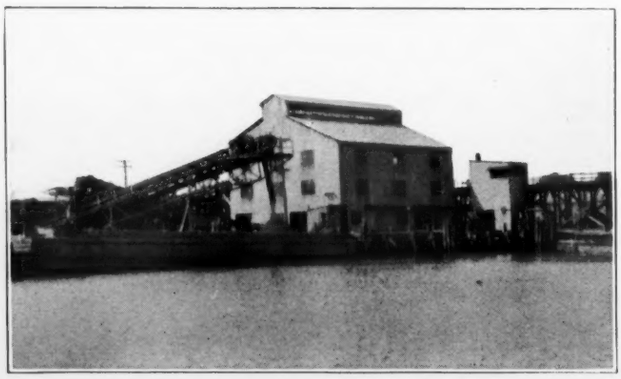
The plant of Lone Star Cement Co. Virginia at Norfolk.

From the screw-conveyors the cement is received by two 77-ft. concrete-incased bucket-elevators which deliver it to the top floor of the pack-house, there to enter a distribution system which supplies the packing-machine hoppers and the bulk-weighing scale hoppers. This distribution system consists of a pair of 16-in. screw-conveyors installed parallel to each other—both serve the same machines—and each screw is fed by its own elevator through a screw-conveyor type of trash screen. The latter consists of a short screw fitted with an 18-in. length of ½-in. by 3/16-in. slotted screen. A rapping device prevents clogging of the material in the screening chamber.

The two distribution screws, besides supplying the two Bates packers, extend out to an inclosed overhead truck-loading platform, where the two Richardson automatic bulk-weighing scales are located. Both screws are reversible and are driven by 15-hp. motors through Jones speed-reducers.

For the delivery of cement in paper or cloth bags two Bates 4-tube sackers are used and provisions have been made for the installation of a third unit. These machines are capable of packing from 16 to 20 bags per min.

Quite a large share of the Lone Star company's product sold in the Washington territory is distributed in bulk, chiefly by means of dry-batch trucks employed on paving and other location-mix jobs. The two Richardson automatic batch-scales provide rapid and accurate means for supplying the constant stream of trucks entering and leaving the yard throughout the day. These scales, which are capable of weighing out 800-lb. batches every 30 sec., depend on photo-electric cells for their rapidity and accuracy. Cement is fed into the scale hoppers by two screw-conveyor mechanisms—a 12-in. screw which delivers the bulk of the batch, and a 4-in. screw which tapers off the delivery toward the finish—which is reached when the scale beam cuts off the light ray of the photo-electric cell. The cement batch is discharged to the container section in the truck bodies through a flexible canvas spout.



Marl plant at Chuckatuck, Va. James River in foreground.

Sack-storage, cleaning and repair room at the pack-house.

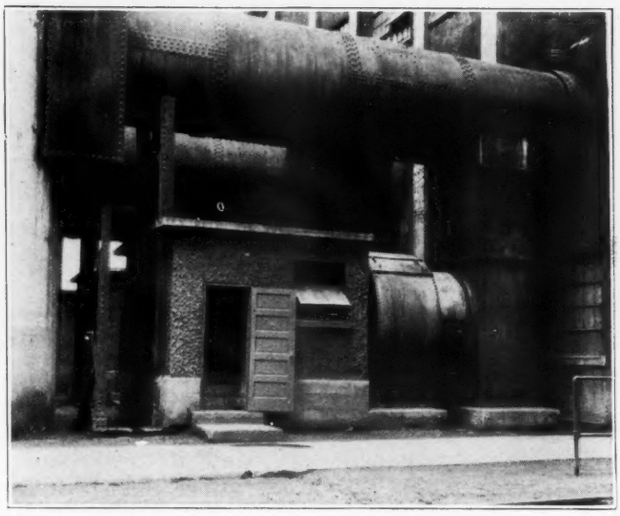
Spillage from the packing machines is returned to the two pack-house elevators by two series of

9-in. screw-conveyors each of which serves one machine. A W. W. Sly dust-collector, consisting of a Sirocco No. 45 fan with a cyclone collector, eliminates the dust coming from the packing machines and other sources.

One of the floors of the pack-house is devoted to the cleaning, repairing and storage of cloth cement bags. A centrifugal-type cleaner, installed in one corner of the room, has a duct connected to the dust-collector system. Bags are tied and sent to the packing machines through metal chutes installed at the work table.

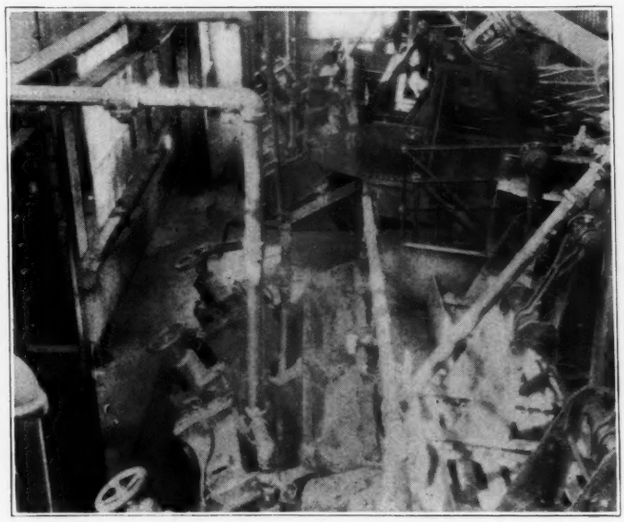
Norfolk Mill Improvements

At Norfolk, Va., and its marl plant at Chuckatuck, Va., the Lone Star Cement Co. Virginia, Inc. has made many improvements in practically all its



One of the induced-draft-fan installations on the kiln stacks.

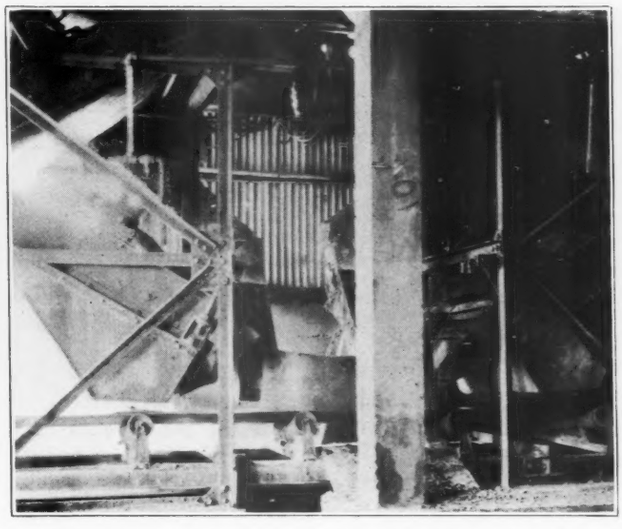
departments. These improvements were made largely in the desire to lower production costs and to eliminate waste in the preparation of marl. Expansion is reflected in the erection of a new silo-storage unit affording an additional 117,000 bbl. storage capacity.



First battery of vibrating screens at Chuckatuck for removing sand from marl.

Closed-circuit vibrating screens in the raw-grinding mill.

At the Chuckatuck, Va., division of the Norfolk mill marl in its raw state is received from near open-pit mines, and is washed and classified. The presence of considerable sand in the pit-run material formerly caused the wasting of fine marl. Experiments with vibrating screens proved the practicability of eliminating most of the sand through fine screening. Accordingly a battery of Tyler Hum-mer screens was installed in the flow-line following the Dorr washers. Clay and fine sand in suspension flow off with the wash water from the Dorr units. The washed marl with the heavier sand is then received on four 3-ft. by 2-ft. 6-in. Hum-mer single-deck screens which are fitted with 3.5-mesh wire-cloth screens. These units, mounted at an angle of 33 deg., send their product to the loading conveyor, and the "throughs" to 2 Hum-mer 3-ft. by 4-ft. vibrating screens. Fine materials through the 10-mesh wire cloth of these units pass to a third set of Hum-mer screens which are fitted with 22-mesh wire-cloth screens. Through the latter units, most of the fine sand is screened out, the plus-22-mesh material being recombined with the



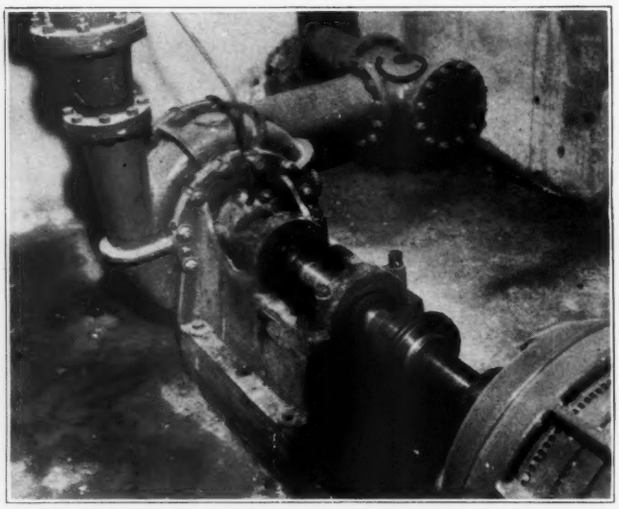
Lower units of vibrating screens at the marl-preparation plant at Chuckatuck.

other marl sizes to be sent to Norfolk on barges on James River.

In the raw-grinding department a battery of vibrating screens was installed for closed-circuit operation with the two Kominuters. These screens, which replace a pair of centrifugal-type separators, have increased the capacity of the Kominuters no less than 10 bbl. each per hr., or an increase of 15 to 18 per cent. In addition to the capacity increase, better fineness of slurry is obtained, a 24-mesh product now being sent to the tube-mills. There are four Hum-mer screens in the battery, two for each Kominuter. They are 4 ft. by 5 ft. in size with single-deck screen panels. The units are mounted on an angle of 30 deg. and are operated by Tyler V-40 vibrators.

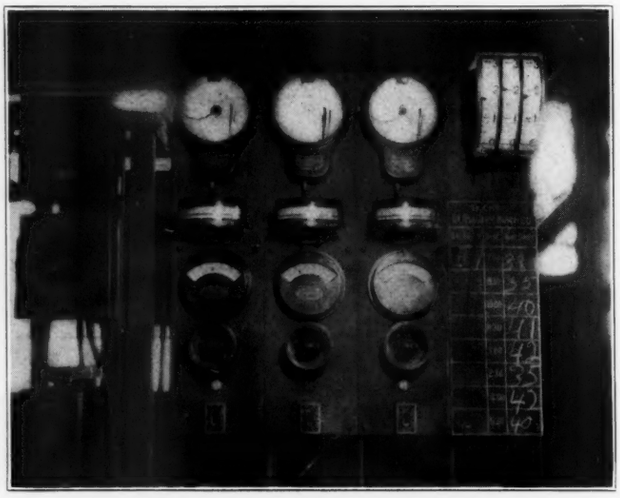
Additions were also made in the slurry-storage and blending department in the form of three 600-bbl. tanks with a pump-circulation system. These tanks provide additional storage and better consistency of the kiln feed. Each tank is piped to a Morris 6-in. slurry pump (driven by a 100-hp. General Electric motor at 900 r.p.m.), which discharges to any of the tanks or to the kiln-feed tanks. The use of the pump aids the paddle agitation and improves the control over the slurry feed.

In the autumn and winter of 1929 evaporating chains were installed in the three kilns to improve the clinker burning and increase the capacity. The chains are installed in a 50-ft. section of each kiln from a point 14 ft. from the feed end (the kilns are 220 ft. long). Each chain consists of a 11-ft. 6-in. length of $\frac{5}{8}$-in. links and there are 27 lengths hung in each circle. The chains are hung in the familiar F. L. Smidth system, *i. e.*, overlapping segments



The 6-in. pump used to maintain circulation and aid in control of the slurry.

with each chain are suspended at an angle to the axis of the kiln and dip nearly to the center of the kiln. Some idea of the effect of the evaporating chains can be gained from the fact that the reduction of the temperature at the base of the stacks has amounted to approximately 600 deg., the temperatures before the installation varying from 1,000 to 1,200 deg. and those after the installation from 500 to 600 deg. Because of the kiln cross-sectional area restriction, the draft at the base of the stack was reduced to .05 in. of water. To compensate for this drop, three American Blower Co. 72-in. induced-draft fans were installed near the base of each stack to raise the draft at this point to an amount varying from .15 to .20 in. of water. By-passes from the kilns to the stacks are provided by the former breeching which is retained for use in the event of the failure of any of the fans. A net increase of 20 per cent, in capacity has been reported for the kiln department through the evaporating-chain installation.



The new meter panel for controlling the kilns.

A new meter panel was installed for the kilns to improve the accuracy of operation under the new conditions brought about by the use of evaporating chains. The panel adjoins the kiln-motor control-apparatus panel and upon it are mounted Tycos recording pyrometers, fan-temperature indicators, draft indicators, r.p.m. counters, tachometers, and a table for a chalk-mark record of the inches of slurry burned during 1½-hr. periods for both operating shifts.

Additional storage capacity for 117,000 bbl. of finished cement was provided through the construction of a 6-silo storage unit in the autumn of 1929. The new unit was erected opposite the original storage and pack-house department, facing the water-front. Its silos, each 32 ft. in diameter and 80 ft. high, were erected by the Macdonald Engineering Co. The unit is equipped with a Weller screw-conveyor system of recovery which delivers to the pack-house. Its individual units are driven through James speed-reducers.

Extending through the center bins of the new silo-storage unit, is a belt-conveyor system leading from the pack-house to barges on the water-front. Its purpose is to transport bags of cement from the plant for water-shipment. The system consists of two units, both equipped with 30-in. belts. The first section extends from the pack-house to the dock at the water-front, where it discharges to a conveyor unit supported by an A-frame which, through a small winch, raises or lowers it to feed

(Continued on page 48)

Quarrying Method and Costs of Trinity Portland Cement Co., Fort Worth*

By J. WILLIAM GANSER
Chief Chemist, Trinity Portland Cement Co.

THE Trinity Portland Cement Co. of Dallas operates three plants in Texas: one in Dallas, one in Fort Worth, and the other in Houston. In the spring of 1923 W. H. L. McCourtie, president of the Trinity company, became interested in the possibility of building a cement plant in Fort Worth to supply the rapidly-growing demand for cement in west Texas. After considerable prospecting south and north of Fort Worth, it was decided that the best lime rock and shale for cement purposes were north of Fort Worth. A property consisting of 600 acres, about 5 mi. north of Fort Worth, was obtained and ground was broken in the fall of 1923 for the machine-shop and stock-room. In order to get a building on the ground quickly the old power-house at the Dallas plant was dismantled and set up at Fort Worth. This old building had housed three 750-hp. Allis-Chalmers gas-engines, which were being dismantled because of a gas shortage which resulted in the installation of a waste-heat power-plant at Dallas. After the erection of this building at Fort Worth the work progressed slowly until the spring of 1924, when machinery began to arrive. Gradually during the following months the required buildings were erected and the machinery installed. Operation was started in the early part of May, 1925, and the first clinker was ground into cement on May 23.

In the lay-out of the plant the plan was to have all the buildings as close to one another as possible and to have everything compact so as to require the least amount of labor. The plant is directly adjacent to the quarry, which is situated on a gradual slope to a small creek which usually is dry during the summer. The only vegetation on this slope was sparse grass and cactus and, as there was little soil, no stripping was necessary before opening the quarry.

Geology.—The rock and shale are of the Washita division of the Comanchean series of the Cretaceous period. The shale or marl is called Kiamitia, and the rock is called Lower and Upper Duck Creek limestone. The highest points on the quarry have a thin layer of Fort Worth limestone. These formations dip from the northwest to the southeast, at an inclination of about 50 ft. to the mile. The Kiamitia formation, as exposed under the Duck Creek limestone, is dark bluish, extensively laminated, and slightly calcareous. It is about 30 to 35 ft. thick and, where exposed, weathers readily.

The following is an analysis of the Kiamitia shale found directly under the Duck Creek limestone:

Silica	52.80 per cent.
Iron oxide	2.86 per cent.
Aluminum oxide	14.24 per cent.
Calcium carbonate	19.08 per cent.
Magnesium carbonate	2.45 per cent.
Loss on ignition	6.59 per cent.

Only the upper 1 ft. or 2 ft. of the Kiamitia shale is quarried, but it has been found through cores that the bottom portion, which is next the Goodland limestone, is a dark blue clay marl with bands of sandy, calcareous material. In the middle section are thin limestone layers and several calcareous sandstone flag layers each 2 or 3 in. thick.

The Lower Duck Creek formation is a series of compact, soft limestone strata. It is about 35 ft. thick, and is characterized by a remarkable sequence of zones containing ammonites. These limestone strata are separated by many seams of a soft limestone 2 and 3 in. thick which easily disintegrate. The following is an analysis of the limestone taken from one of these seams:

Silica	21.80 per cent.
Iron oxide	3.45 per cent.
Aluminum oxide	13.15 per cent.
Calcium carbonate	53.52 per cent.
Magnesium carbonate	1.50 per cent.
Loss on ignition	5.10 per cent.

Analysis of the Lower Duck Creek limestone is as follows:

Silica	6.02 per cent.
Iron oxide	1.29 per cent.
Aluminum oxide	3.38 per cent.
Calcium carbonate	84.96 per cent.
Magnesium carbonate	1.75 per cent.
Loss on ignition	1.50 per cent.

The Upper Duck Creek limestone or limy marl, at the present quarry face, is about 10 ft. thick. It is a light-colored, yellowish marl containing a conglomeration of fragmental limestone and has the following composition:

Silica	17.70 per cent.
Iron oxide	2.80 per cent.
Aluminum oxide	9.20 per cent.
Calcium carbonate	64.22 per cent.
Magnesium carbonate	2.09 per cent.
Loss on ignition	7.00 per cent.

The quarry was first opened on the rim of an amphitheater-like depression on the headwaters of a fork of Marine Creek, which has cut back the Duck Creek and Kiamitia formations, thereby exposing the Goodland limestone in the creek bed.

Prospecting and Exploration.—Previous to the purchase of the property considerable prospecting was done by persons expecting to interest someone in building a cement plant. What first probably attracted their attention was a 50-ft. face of rock on Marine Creek about ½ mi. north of the present quarry. Rock from this bluff was completely analyzed by us before we bought the property lower

* Reprinted from U. S. Bureau of Mines Inf. Circ. 6,513.

down the creek. From the analyses we were convinced that Portland cement could be made from the rock in this locality. Two holes were drilled on the property, one 100-ft. deep and the other 64 ft. deep. The 100-ft. hole showed 80 ft. of limestone and marl and 20 ft. of shale; while the 64-ft. hole, which was drilled further down the slope, showed 48 ft. of rock and 16 ft. of shale.

After the property was purchased we drilled six holes with a Cyclone drill to get more data as to the quality and thickness of the limestone. Samples from these holes showed that we had from 20 to 45 ft. of rock over the area prospected. In each instance we drilled into the shale and all the samples showed that it was quite uniform.

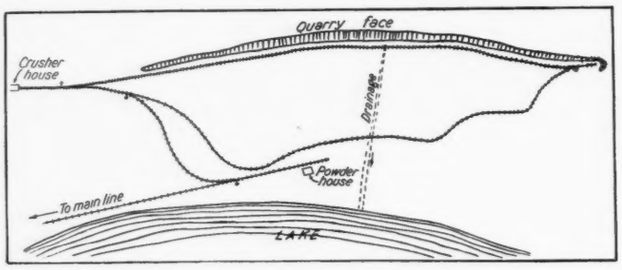


Fig. 1. Track lay-out and line of quarry face.

Table I shows the analysis obtained on material from the deepest hole, each sample representing 5 ft. of depth.

TABLE I.—ANALYSES OF MATERIAL FROM DEEPEST DRILL HOLE

Sample No.	Silica (*per cent.*)	Iron and Aluminum Oxide (*per cent.*)	Calcium Carbonate (*per cent.*)	Magnesium Carbonate (*per cent.*)
Rock:				
1	7.62	4.74	85.11	2.01
2	14.18	8.18	74.96	2.51
3	14.16	8.48	72.28	1.42
4	12.62	8.80	75.57	3.37
5	12.10	6.92	77.21	3.19
6	13.33	8.60	75.82	2.74
7	12.96	8.24	74.64	1.71
8	8.94	6.16	81.16	3.00
9	7.26	3.32	85.53	1.45
Shale:				
10	35.68	15.76	44.50	3.39
11	38.88	14.66	40.09	4.04

Quarrying Methods.—In quarrying, little shale is mined with the rock and no shale pit is operated as is customary in other cement-plant quarries. The quarry face, which is 2,000 ft. long contains rock and marl low in lime at the end farthest from the plant and slightly high in lime at the near end. The low-lime and high-lime rock are stored separately and mixed by taking so many crane buckets of one kind to so many of the other and dumping them into the hopper which feeds the tube-mill.

The quarry location had a gentle slope and, therefore, in opening the quarry it was only necessary to shoot the rock and head the shovel into a face about 10 to 15 ft. high. At present the face is about 30 ft. high at the ends and 50 ft. at the center. The rock face is worked in a straight line. The overburden nowhere amounts to over 6 in. Of the 600 acres of land owned by the company 400 to 450 acres is available for quarry purposes.

Drainage of the quarry has been an easy matter since the floor of the quarry is higher than the creek bed and it has only been necessary to dig shallow ditches to carry the water to the creek. While some water stands in shallow pools in the quarry, it only softens the quarry floor to a depth of about 1 ft. There is a stratum of hard shale about 1 ft. under the limestone, which keeps the shovel and ties from sinking into the soft shale.

Fig. 1 shows how the track is laid out and the line of the quarry face.

Since the overburden is only about 6 in. in depth it is not removed, but is mixed with the rock when blasted.

The quarry begins near the end of the plant and the face extends straight away from it; therefore, the haulage is short.

When the plant is running at full capacity it is necessary that the quarry operate 10 hr. per day, 6 days a week, producing from 1,200 to 1,500 tons a day. Only 6,000 to 8,000 tons of rock is shot down ahead of the shovel to prevent the water-soaking of large quantities of rock in wet weather. If the rock is thoroughly wet, the marly part becomes sticky and it is difficult to handle in the preliminary crusher.

While the rock face is 50 ft. high at its maximum it is never this high after being shot. An effort is made to shoot the rock so that it is not usually over 30 ft. high in front of the shovel. The width of the shovel cut is about 40 ft.

Drilling and blasting.—The rock is drilled in the usual way by putting down well-drill holes, for which a 4-in. Sanderson-Cyclone electrically operated drill on tractor wheels is used. This drill is operated by a 15-hp., 440-v., 720-r.p.m., variable-speed motor. The holes are drilled 14 to 16 ft. from the face and down to the shale. Only one row of holes 16 to 18 ft. apart is drilled at a time. These holes are shot one at a time, and only three or four are shot ahead of the shovel. This method of shooting was adopted to keep concussion to the minimum.

The drill bits are of tool steel, 4 in. wide with a 45 deg. slope on the drilling edge. Two men operate the drill 10 hr. a day and drill about 120 ft. These men are paid by the hour, one receiving 40 and the other 30c. At this rate the labor cost is from 6¼ to 7 c. per ft. drilled.

As the holes vary from 20 ft. to 60 ft. in depth, the amount of dynamite put into a hole varies. The maximum amount put into a hole—a 60-ft. hole—is one box or 50 lb. All the dynamite is put into the bottom of the hole, as it is the rock at the bottom that needs shattering. The top part—1 ft. to 10 ft. —needs no shooting, since it is a conglomerate of small rock and marl. When the bottom is shattered and pushed out by the shot, the top is easily broken by the movement.

The dynamite used in these drill holes is 4-in. by 8-in., 40-per cent. gelatin. Cordeau-Bickford is used on all primary shots and is set off with a No. 6 detonator. The holes are loaded in the usual manner, and tamped with dirt by a wooden pole on a rope.

Very little secondary shooting is necessary. The few rocks that are too large for the crusher are laid

aside by the shovel and at some later time are shattered by "doby" shots. From one to four 1¼-in. by 8-in. sticks of 40-per cent. gelatin dynamite are placed on the large rocks with a fuse about 30 in. long and covered with mud.

Loading.—All the stone is loaded by a 50B Bucyrus electric crawler-type shovel with a 2-cu. yd. dipper. A 100-hp., 2,200-v. motor drives a generator which delivers 230-v. current to a 60-hp. motor on the hoist of the dipper, a 13-hp. motor which swings the shovel, and a 13-hp. motor on the thrust. A 5-hp. motor on the dipper trip, a 2-hp. motor on the air-compressor, and a 7½-hp. motor on the exciter are run by 440-v. current received through a transformer from the 2,200-v. leads. This system of motors is called the Ward-Leonard control. It is necessary to have only one man on the shovel and one man in the pit, who removes large rocks that might fall on the track and also signals with a flag to the tower man as to where to stop the electric car and when to move it after it is loaded.

When the quarry was first opened a Model 32 Marion crawler steam-shovel, with a 1-cu. yd. dipper, was used. After several years this was proved to be too small to supply the quantity of rock necessary, and the bank became too high to operate so small a shovel safely. Since the crushing plant was being run entirely by electric power it was then decided best to purchase an electric-shovel, thereby eliminating the necessity of maintaining a waterline in the quarry and also the purchasing of coal.

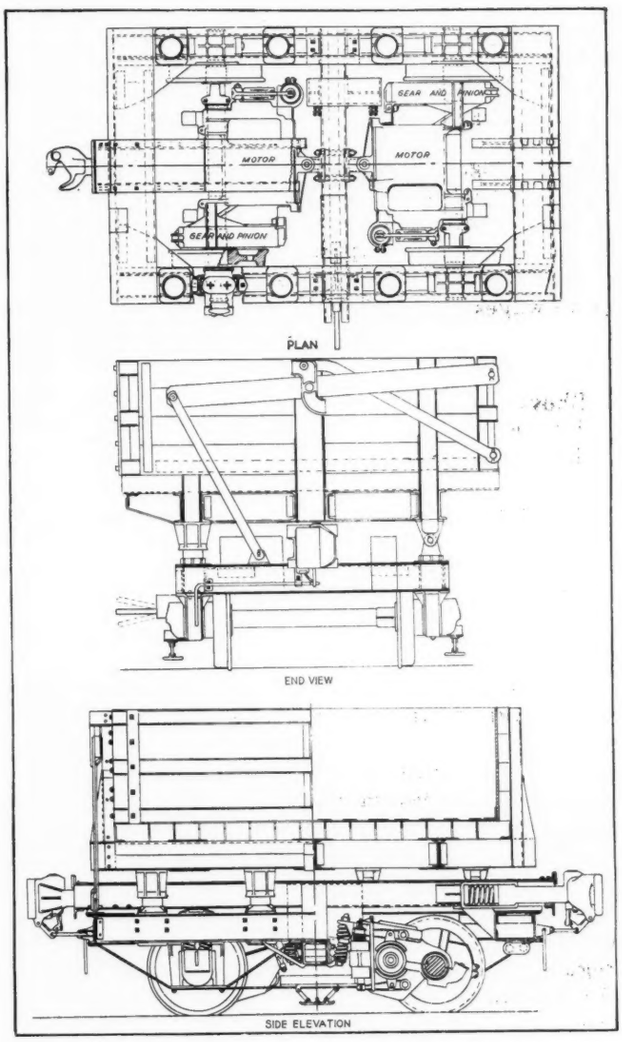


Fig. 2. Drawings showing design of the electric quarry cars.

Transportation. — Transportation from the quarry to the plant is by the Woodford electric-haulage system controlled by an operator in a tower which, in this instance, is in the plant above where the cars are dumped into the receiving hopper.

The cars, of 10-cu. yd. capacity, were built by the Western Wheeled Scraper Co. They are of composite wood-and-steel construction and are of the one-way, side-dump type. Each car has two 30-hp. Allis-Chalmers motors, each of which drives an axle through direct single-reduction gearing. Three cars are being operated and each is equivalent in power to a 35-ton locomotive, as each will easily switch a box-car of gypsum to the place of unloading. Fig. 2 shows the design of the cars.

The Woodford system employs a third rail using 250-v. direct current. In some installations this third rail is between the haulage rails, but at this property it is placed on the outside of the rails. It was found that the third rail, when between the two haulage rails, interfered when switching box-cars; therefore the third rail was placed on the outside on the whole system.

Operation of the system is simple, as everything is in full view of the tower operator from the time the cars leave the crusher-building until they are loaded and returned to it. Each controller provides for three running speeds, one "off" position for coasting, and three brake positions for various brake pressures. With the controller handle in the "off" position a car will coast until the brake current is turned on. The controls are set so that the operator need not attend to the cars except for a few feet at the loading and discharge ends where they require accurate "spotting." The 3-speed control gives the cars a range of speed from 12 to 16 mi. per hr.

The track system comprises one track leading from the crusher-house to a switch, and two branches from the switch joining to form a long loop. One side of this loop is parallel to the face and is kept near it to serve as a loading track. The other is away from the face and is called the passing track. The usual method is to send empty cars out over the passing track and around the loop, "spotting" a car at the shovel as soon as the car preceding it has been loaded and sent to the crusher.

The device which dumps the cars at the crusher is also operated by the haulage man. It consists of two hooks which are attached to a frame and yoke. Two chains from this yoke go to cam-quadrants on which the chains wind as the quadrants revolve. The weight of the yoke and hooks is balanced by counterweights fastened to wire ropes which are wound on sheaves on the same shaft as the quadrant. When this shaft is turned by a motor through gearing the hooks are lifted, dumping the car side-

wise, not only quickly but smoothly, and the car body is set back on the bolsters with very little jar. Fig. 3 shows the design of the car-dumper.

Crushing Plant.—The cars are dumped into an 18-ft. by 20-ft. steel-lined hopper from which the rock is discharged by a pan-type feeder, driven by a 5-hp., 440-v. motor, to a No. 7 Mammoth Williams hammer-mill, driven by a 250-hp., 2,200-v. 750-r.p.m. motor. The feed to the hammer-mill consists of pieces ranging from a 3-ft. cube to the ⅛-in. size.

The discharge from the Williams mill is elevated by a 42-in. pan-elevator, driven by a 25-hp. 2,200-v., 720-r.p.m. motor, and discharged on a short belt 30 in. wide—driven by a 5-hp., 440-v., 720-r.p.m. motor—which carries the rock over a wall into the rock storage.

Following is a screen analysis of the discharge from the Williams mill:

Size of Mesh Passed	Per Cent.
1½-in.	89.5
1 -in.	84.5
¾-in.	75.7
½-in.	67.7
¼-in.	59.0
⅛-in.	30.2
20-mesh	16.7
30-mesh	9.5
50-mesh	5.6
100-mesh	2.7

The rock after arriving in storage is either put into the section for low-lime or high-lime rock, or taken to the bins feeding the tube-mills. The rock storage is 75 ft. wide and 178 ft. long and has a capacity of 10,000 tons. The rock is moved in storage by a Shepard 6-ton traveling crane equipped with a 3-cu. yd. clam-shell bucket. This crane has a span of 75 ft. and is equipped with a 10-hp., 1,200-r.p.m., 440-v. trolley motor, two 40-hp., 900-r.p.m., 440-v. hoist motors, and a 40-hp., 900-r.p.m., 440-v. bridge motor. These motors have variable speeds.

As already stated, the quarry is arranged so that high-lime and low-lime rock mixtures may be made. These mixtures can be further varied by adding different proportions of the rock from the crane bin. This creates uniformity and reduces the need for correction after the raw material has been ground into slurry.

The two tube-mills for grinding the raw mixture are adjacent to the rock-storage and are fed from a hopper loaded by the crane. They are 8-ft. by 30-ft. Traylor combination mills, each driven by a 700-h.p., 2,200-v., 180-r.p.m. motor. Each of these mills has three compartments, so that the reduction is in three stages. The total weight of the grinding media per mill is 70 tons, of which 20 tons of 2-in. by 4-in. balls is in the first compartment, 20 tons of 1½-in. balls is in the second compartment, and 30 tons of 1-in. by 1¼-in. slugs is in the third compartment. The balls consumed per ton of material ground amount to 0.304 lb. Tube-mill liners last from two to three years. The raw slurry from the mills contains 40 per cent. of moisture, and 90 per cent. of it will pass a 200-mesh screen. The two mills grind at the rate of 29.39 tons per hr., or 14.70 tons per mill per hr.

The slurry from the mills flows to a bucket-elevator pit from which it is elevated to silos, where it is agitated before being fed to the kilns and burned at 2,700 deg. F. into Portland-cement clinker. Fig. 4 shows the flow-sheet from the quarry to the kilns.

TABLE II.—ACCIDENT RECORD OF THE PLANT SINCE 1927

Year	Days Lost per 1000 Man-hours	Man-hours Worked
1927	0.528	261,542
1928	0.109	301,378
1929	0.403	431,670
1930	0.000	371,752

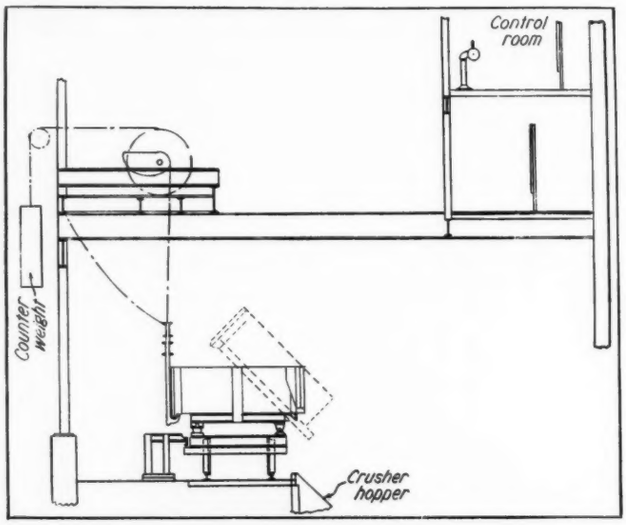


Fig. 3. Arrangement for dumping cars.

Wage Scales—No regular foreman is employed in the quarry, the superintendent, or mill foreman supervising when necessary. The quarry men receive wages as follows:

Position	No. of Men	Hourly Wage
Shovel operator	1	$0.65
Pit men	1	.35
Driller	1	.40
Driller's helper	1	.30
Powder man	1	.50
Crusher tender	1	.40
Crusher tender's helper	1	.30
Tower man	1	.60
	8	

Safety Organization.—The idea of safety is being brought to the men at this plant in an unusual but impressive manner. All those guilty of breaking the safety rules, is found out, appear at a court held each Monday morning and are tried for the offense.

A judge is elected to preside over the court, select the jury, appoint the prosecuting attorney, and perform such duties as befall a judge in a regular court. A sheriff is elected, and he is a man whose regular duties as an employee require that he go through the entire mill several times a day. It is the duty of the sheriff to see if he can detect any employee doing a careless act or anything that may

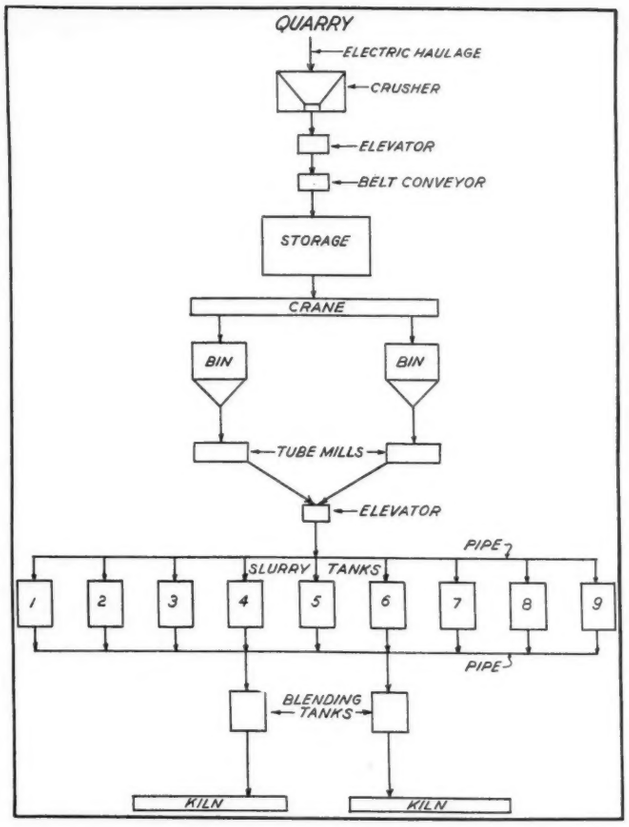


Fig. 4. Flow-sheet of raw materials.

endanger himself or his fellow workers. Should he discover anything of this nature, he files charges with the court clerk, who issues a notice to the man to appear at the next meeting of the court to answer the charge turned in by the sheriff. The sheriff also notifies any witnesses that he is able to find. Any employee in the mill can file charges through the sheriff and court clerk.

At five minutes to 10 o'clock each Monday morning, at the regular safety period, the plant whistle blows, indicating that the men in each department selected by the department foreman are to appear in the court-room—the regular first-aid room. The foreman has no trouble whatever in getting the men to come to the court, for they would all come if allowed.

TABLE III.—SUMMARY OF COSTS, JAN. 1 TO DEC. 31, 1929
Stone (including overburden), loaded during period, 294,883 tons
Operating Costs per Dry Ton of Stone Mined

	Labor	Air Drills	Power Costs	Explosives	Other Supplies	Total
Mining:						
Drilling	$0.0082	$0.0008	$0.0002	.....	$0.0006	$0.0098
Blasting	.0058	.....	.....	$0.0250	.....	.0308
Loading	.0203	.....	.0015	.....	.0075	.0293
Transportation	.0306	.....	.0028	.....	.0119	.0453
Crushing	.0139	.....	.0087	.....	.0121	.0347
Grinding	.0341	.....	.1191	.....	.0274	.1806
Elevating	.0029	.....	.0005	.....	.0048	.0082
Conveying	.0029	.....	.0005	.....	.0011	.0045
Miscellaneous plant	.0147	.....	.....	.....	.....	.0147
Total operating costs	.1334	.0008	.1333	.0250	.0654	.3579
Depreciation	.0300	.....	.....	.....	.....	.0300
Depletion	.0100	.....	.....	.....	.....	.0100
Taxes	.0100	.....	.....	.....	.....	.0100
Insurance	.0100	.....	.....	.....	.....	.0100
Miscellaneous overhead	.0200	.....	.....	.....	.....	.0200
Total costs	$0.2134	$0.0008	$0.1333	$0.0250	$0.0654	$0.4379

TABLE IV.—SUMMARY OF COSTS IN UNITS OF LABOR, POWER, AND SUPPLIES, JAN. 1 TO DEC. 31, 1929
Stone (including overburden) loaded during period, 294,883 tons

	Mining	Crushing	Total
A. *Labor* (man-hr. per ton):			
Drilling	0.0215		0.0215
Blasting	.0142		.0142
Loading	.0330		.0330
Haulage	.0534		.0534
Miscellaneous	.0111		.0111
Total labor	.1332		.1332
Average tons per man per shift			47.52
Labor, per cent. of total cost			37.24
B. *Power and supplies:*			
Explosives (lb. per ton)			.1639
Total power (kw.-hr. per ton)[1]			14.0196
Shovels	.0015		.0015
Haulage[2]	.0028		.0028
Drills	.0008		.0008
Crushing		0.0087	.0087
Elevating		.0048	.0048
Conveying		.0011	.0011
Tube-mills		13.9999	13.9999

[1]Average cost of power is $0.008 per kw.-hr.
[2]Power includes that used on both locomotives and electric-haulage system.

TABLE V.—DETAILED AVERAGE SHOVEL COSTS, DIRECT OPERATION, JAN. 1 TO DEC. 31, 1929
Type of shovel, 50-B Bucyrus; size of dipper, 2 cu. yd.; stone loaded, 294,833 tons.

	Stone Cost	
	Total	Per Ton
Engineers	$ 3,002.25	$0.0102
Pit man	1,394.35	.0047
Total operating labor	$ 4,396.60	$0.0149
Fuel or power	454.12	.0015
Grease and lubricants	199.29	.0007
Coal—crane expense	735.50	.0025
Total supplies	$ 1,388.91	$0.0047
Shovel-repair labor	1,587.40	.0054
Repair supplies	1,283.96	.0043
Total repairs	$ 2,871.36	$0.0097
Total shovel operation	$ 8,656.87	$0.0293

The meeting is called to order promptly at 10 o'clock, and the minutes of the previous meeting are read by the secretary. We then have a short discussion on the ways and means of preventing accidents, asking for suggestions from the men.

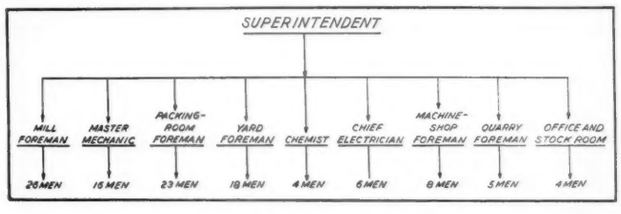


Fig 5. Organization chart.

We get our best recommendations from the men who do the actual work where hazards exist. These recommendations are put in the minutes of the meeting and are read the following week, giving an account of those carried out.

The meeting is then turned over to the judge (shipping foreman), who opens the court by giving a brief talk on the purpose of the court stating that it is not intended to create any personal feeling, but that it is all in a spirit of fellowship.

The judge then has the first case on the court docket read by the clerk, asks for corrections, appoints a jury, swears in the witnesses, and turns the case over to the prosecuting attorney. The

latter and the attorney for the defense (selected by the defendant) have 10 min. each in which to question the witnesses of both sides and the defendant himself, and 5 min. each to sum up and plead the case to the jury. When the defense rests the case, the jury retires to the jury room for not more than 3 min., after which time it returns a verdict of guilty or not guilty.

If the defendant be found guilty, the judge lectures the prisoner on safety work and particularly

TABLE VI.—DETAILED SUMMARY COSTS, DIRECT OPERATION, JAN. 1 TO DEC. 31, 1929

	Stone Cost	
	Total	Per Ton
Total all shovels	$ 8,656.87	$0.0293
Drilling:		
Operating labor	2,357.20	.0080
Air, gas, power	69.90	.0002
Operating supplies	168.50	.0006
Repair labor	60.15	.0002
Repair supplies	229.00	.0008
Total drilling	$ 3,723.23	$0.0098
Blasting:		
Labor	1,697.30	.0058
Explosives	7,372.71	.0250
Total blasting	$ 9,070.01	$0.0308
Haulage:		
Locomotives	3,533.40	.0119
Cars	1,531.31	.0051
Track maintenance	8,359.58	.0283
Total haulage	$13,424.29	$0.0453
Grand total	$34,036.00	$0.1152

on safety work in line with the case just tried, which lecture incidentally is for the benefit of the entire court.

In the autumn of 1929 practically the entire plant was given first-aid training by the U. S. Bureau of Mines. Since then six men have formed a first-aid team and have on several occasions entered first-aid contests in Fort Worth and Dallas.

Pack-House Facilities Aid Distribution

(*Continued from page 42*)

the transfer conveyor aboard a barge. This is necessary because of the continual change in the tidewater level. The second section of the system is mounted aboard the barge, and acts as a medium of transfer to the barges anchored in the deeper channel of the river. Aboard the barge is a stationary 30-in. conveyor unit which discharges to a short unit also supported by an A-frame. Through the latter's ability to be raised or lowered, sacks of cement are easily stacked to any height aboard the barges. Electric lights on the barge allow loading at night.

The Lone Star improvements at Norfolk show an increase in capacity of approximately 20 per cent., or in more concrete figures, 600 bbl. per day, raising its output capacity to 3,600 bbl. per day.

The Nonmetallic Minerals of Florida

(*Continued from page 36*)

a few years ago near Camp Walton, Okaloosa County, western Florida, and was used to make a sap-brown dye for wrapping paper.

Diatomite

Diatomite, known also as "infusorial earth" or diatomaceous earth, consisting of siliceous skeletons of diatoms, which are microscopic water plants, occurs as sedimentary beds of various geological ages in many parts of the world. In most other states the diatomite is a part of the earth's crust, with later deposits overlying it, but all the Florida deposits are associated with peat or muck, and are apparently in process of formation to-day. Some of the peat deposits of Florida contain such a large amount of diatoms that the peat is ashy gray when dry; and weighs about 20 lb. to the cu. ft., air dry, and when the carbonaceous material is removed by burning, the residue is a white mass of surprising lightness, weighing about 8 lb. per cu. ft. It is used chiefly for insulating and polishing.

The best-known deposits are in Lake County, central peninsular Florida, and so far this is the only section in which development has taken place. However, deposits are known in other sections, as for instance, Lake Wales in Polk County, southern Florida, and in the valley of Choctawhatchee River, Santa Rosa County, western Florida.

Other Minerals

Sulphur.—A single boulder of crystallized sulphur was dredged from a total depth of about 70 ft. in a hard-rock phosphate mine in Citrus County in 1907. This is the only recorded instance of sulphur in this form having been found in Florida. The pit in which this particular boulder was recovered and the immediate surroundings has been thoroughly prospected but with negative results.

Gypsum.—Deposits of gypsum occur in the Lake Panasookee region of central peninsular Florida. These have not been prospected very thoroughly but it has been determined that the several individual deposits contain quite a tonnage, probably sufficient to encourage a small development. The manner of occurrence in low hammocks surrounded by more swampy areas, and the remoteness from transportation facilities have discouraged development.

Production

Table II shows the quantity and value of the mineral products of Florida in 1928 and 1929. In the case of less than three producers of a given mineral product the figures are combined so as to not divulge individual operations.

Table II.—MINERAL PRODUCTION OF FLORIDA, 1928 AND 1929

	1928		1929	
	Quantity	Value	Quantity	Value
Pebble phosphate.....*long tons*	2,729,334	$8,953,798	3,015,874	$9,633,856
Hard rock phosphate..*long tons*	92,627	370,508	72,733	267,218
Limestone.....*tons*	3,368,600	2,624,493	2,258,130	1,669,245
Kaolin.....*tons*	46,496	630,471	40,904	544,848
Common brick.....*thousands*	39,857	343,369	.....	278,849
Other clay products.....	.....	57,607		
Sand and gravel.....*tons*	894,879	495,875	788,298	422,409
Sand-lime brick.....*thousands*	6,327	57,866	3,748	39,937
Peat.....*tons*	800	7,200	14,450	130,050
Mineral waters (estimated)....	.....	75,000	.....	100,000
All others (lime, cement, crushed flint, fuller's earth, diatomite, and rare earths)..	.....	2,223,891	.....	2,479,684
Totals.....		$15,840,078		$15,566,096

A Study of Factors Which Determine the Maximum Lime in Cement Clinker

By EUGENE GEARY
Chemist, Pittsburgh Plate Glass Co.

IT is almost universally agreed that the higher lime compounds in cement clinker determine the strength of the finished product. It is also known that the amount of lime a clinker may carry before giving an unsound product is limited by certain factors. This study is offered in an effort to gain a more completed understanding of these factors and of their effect on an attempt to manufacture a high-strength cement.

It was noticed at one time that, as long as mill conditions and raw materials remained the same and the burning was complete, the ratio between the combined lime and the silica, alumina and iron oxide was almost the same, even though the lime content was so high that the cement was unsound due to the presence of free lime. This led to the idea that this ratio gave an indication of the maximum lime that the clinker could carry under these conditions of composition and fineness of raw materials. After this condition had been noted several times, it was decided to make an attempt to study the factors which determined the maximum amount of lime a clinker could carry without the formation of free lime. It was thought that, by burning clinkers of different composition and of different raw fineness and determining the free lime and, thus, the lime combined, some insight into the effect of these factors on the combination of the lime during burning could be obtained.

An attempt was first made to determine the effect of a variation in the silica and alumina on the amount of lime which would combine. In order to accomplish this it was decided to control the other variables by using materials free from iron oxide and magnesia and by grinding all materials to a fineness of 90 per cent. through the 200-mesh sieve and by burning at a rate simulating practice to 1,500 deg. C. The raw materials used were kaolin, calcite and silica. A series of reaction cones was made up with the same amount of lime, but with the silica varying from that in kaolin to almost pure silica. This variation was chosen as the shale or clay used in practice may be considered as kaolin plus a certain amount of silica. This series of cones was all burned at the same time. Each of the cones was then analyzed, the free lime determined, and the ratio between the lime combined and the silica and alumina calculated. These ratios were then plotted against the silica-alumina ratios to give the curve shown in the diagram.

According to present ideas of clinker composition, the clinker would contain the highest lime possible when the silica and alumina have combined with lime to form tricalcium silicate and the tricalcium aluminate compounds. Therefore, the curve for this condition was calculated and was called the theoretical saturation curve and was plotted on the diagram for the purpose of comparison. It was noted that the two curves were similar and that, as the alumina decreases and the silica increases, the amount of lime combined increases due to the difference in combining weights of the two oxides. There seems to be evidence that the alumina has very little if any fluxing action at this temperature. Although the low-lime aluminates may have lower melting points, in a high-lime mix of sufficient fineness the higher-lime compound must form at a temperature below the melting point of the lower-lime compound. Therefore, we are dealing here with a reaction which takes place in the so-called "dry state."

The next variable studied was the iron oxide. At this point it was decided to burn samples large enough so that the physical properties of the cements could be studied at the same time, and, if possible, to try to control the lime so that the excess would not be so great. The raw materials used were the same, except that a clay which was found to give 2 per cent. of iron oxide in the clinker was used and pure iron oxide was used in the samples having a lower silica/alumina ratio than the clay. A series of high-lime clinkers was burned under the same conditions as before. Each of these was analyzed and the free lime determined, and the ratios were calculated as before, except that the lime combined with the iron was subtracted. It will be noticed that the curve so obtained is similar to the other curve except that it is nearer the saturation curve than the curve for the mixes containing only silica, alumina and lime. This seems to indicate that the iron oxide has a catalytic effect on the reactions of silica and alumina with lime to form the tricalcium silicate and aluminate compounds. Several samples were then burned in the Portland-cement area of the diagram. These contained increasing amounts of iron oxide and it was found that, as the iron oxide increased, the clinker ratio was closer to the saturation curve. This is possibly the explanation of the high strength of the high-iron cements. It seems that we may increase the amount of lime which the clinker may carry by increasing the iron oxide, but this has a disadvantage in that it produces a darker-colored clinker.

Next an attempt was made to learn if magnesia had any catalytic effect and samples containing 2 per cent. iron oxide as before but also 2 per cent. of magnesia were burned. In calculating the ratios for these samples no allowance for any combination of magnesia was made, as the present theory seems to be that the magnesia remains uncombined.

When the curve for these samples was plotted it was found that it was just a little closer to the saturation curve than the curve for the clinker which contained 2 per cent. of iron oxide and no magnesia. Samples with higher percentages of magnesia up to 29 per cent. were burned and were not found to approach any nearer the saturation curve than those which contained only 2 per cent. of magnesia. This seems to indicate that magnesia may have a slight catalytic effect due to a small amount of some compound that may be formed but that, above this, it has no action and does not have any effect on the amount of lime which will combine.

Attempting to reach the saturation curve by regrinding and burning was the next experiment carried out, and a curve which was very close to the saturation curve was obtained. Then one of the samples was reground and burned again and was found to occur on the curve. As the composition was the same, the increase in the lime which combined must be due to the increased contact surfaces in the process of regrinding and burning. We then burned two samples which would occur in the Portland-cement area of the diagram but in which the raw mix was ground so that all would pass a 200-mesh sieve. It was found that this caused the samples to appear at points closer to the saturation curve than similar samples which were ground to 90 per cent. fineness.

It seems that, after the catalytic effect of the iron oxide, we must depend on finer grinding of the raw mix to increase the amount of lime which will combine. This is easily understood when we remember that the combination of the lime is due to reactions which take place in an unfused condition in the kiln at the point of incipient fusion and that the clinker must not be considered as a completely-fused body. Several commercial cements have been examined in the same way and, when these factors are considered, they appear at points in the diagram similar to those occupied by the experimental clinkers. The combination in practice has been checked in the same way and, when burning is complete, the evidence points to iron oxide as the flux in the same way and the decrease in silica also brings a decrease in the lime combined.

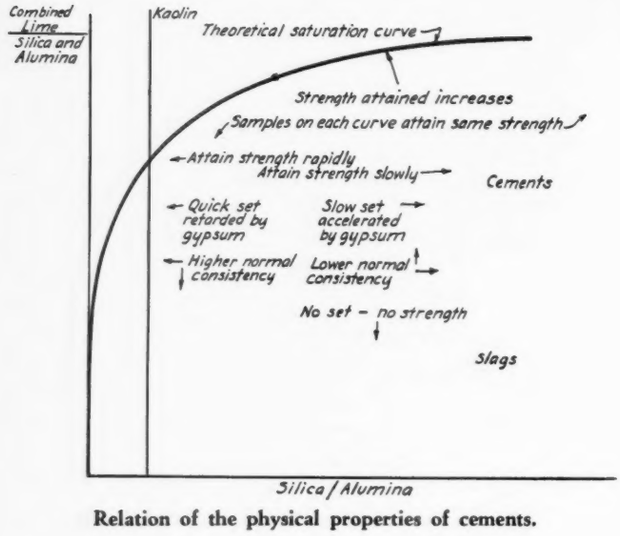
The physical properties studied were the normal consistency, the setting time with and without gypsum, the tensile strength, and soundness. All the clinkers were ground to a fineness of 90 per cent. through the 200-mesh sieve and pats both with and without gypsum were made for setting-time and soundness tests. The normal consistency was judged by the amount of water required to bring the cements to the same workability as determined by hand molding. Sand briquettes were made for each for tensile strength at 2, 7 and 28 days and 3 months.

The soundness seemed to be a matter of the free-lime content of the sample. Clinkers containing over 2 per cent. of free lime were generally unsound. And those containing under 2 per cent. free lime, and with lime enough combined to cause them to set, were sound. The briquettes containing the higher percentages of free lime disintegrated in the water storage.

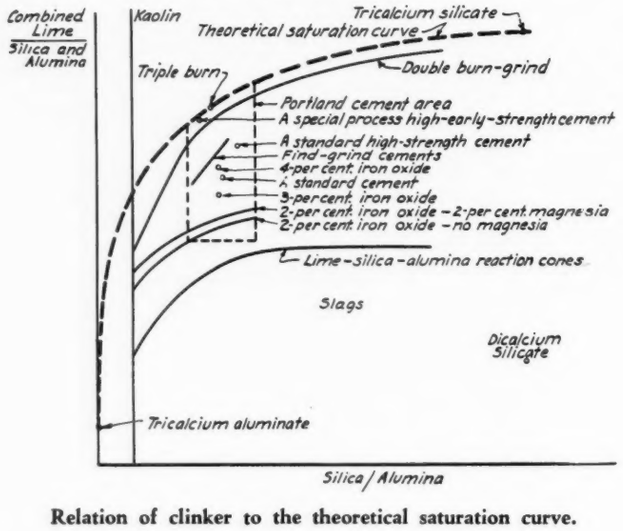
The strength of the low-free-lime cements which were located on the same curve seemed to be about the same at the later periods but as the curve approached the tricalcium-aluminate side, the cements seem to gain this ultimate strength more rapidly. The cements which were located close to the kaolin line gained the ultimate strength for the 2-day test. As the cements approached the saturation curve the ultimate strength was higher.

The setting properties and the effect of gypsum were very marked and rather astonishing. Cements which were near the kaolin side of the diagram were quick-setting but were retarded by the addition of gypsum. The cements on the silica side of the diagram were slow setting and the addition of gypsum seemed to accelerate the set. This phenomena has been noted in practice in the case of a high-silica cement. The normal consistency seemed to increase as the tricalcium aluminate increased or as the lime ratio decreased and, thus, as the dicalcium silicate increased.

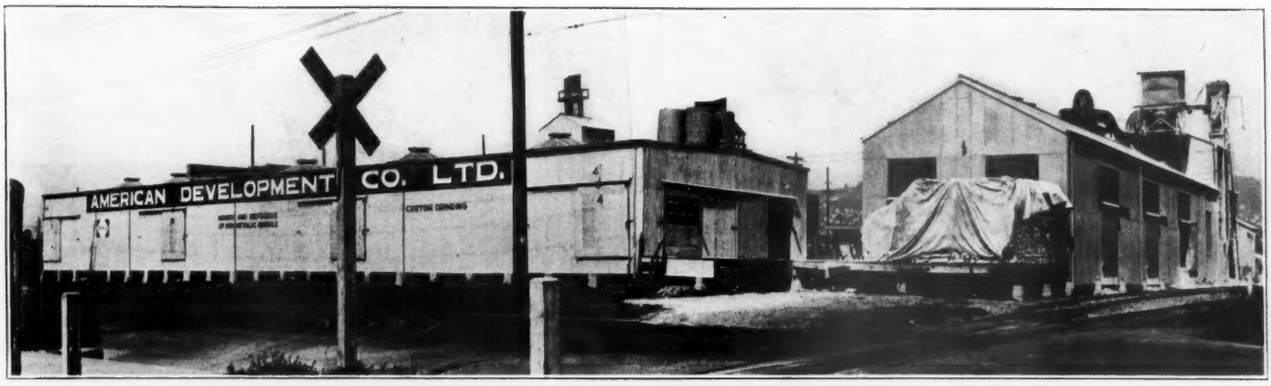
(Continued on page 64)



Relation of the physical properties of cements.



Relation of clinker to the theoretical saturation curve.



The new storage building with Plant No. 1 at right. Part of Plant No. 2 is seen in the background.

California Plant Has Developed Custom Grinding to Meet Any Demand

Second Unit Completed and Third Being Built Since Start of Business in 1930

By W. E. TRAUFFER

THE most recent addition to the growing number of custom-grinding plants in this country is that of the American Development Co., Ltd., at Berkeley, Cal. This company put its first grinding unit into operation in the summer of 1930; in the spring of 1931 a second unit was added; and at present a third complete grinding unit is under construction. Other improvements, which when completed will make this one of the largest and unquestionably the most modern plant of its kind in this country, are also under way. The company is equipped to grind almost any kind of material to any desired specification and has a policy of adding new equipment for special grinding work whenever the demand justifies.

The company's plant is located at 6th and Gilman Sts., Berkeley, in one of the chief industrial districts of that city. The site is ideal as it has access to all the railroads operating in and around San Francisco, it is only a short distance from the docks for water shipments, and is also well located for truck shipments. The property owned by the company is 300 ft. by 600 ft. in extent. The company has the privilege of expanding its holdings to include adjoining property whenever this becomes necessary. All raw material is now being received by rail, while shipments are being made by rail, water and truck.

The first plant put into operation is known as Plant No. 1. Material is discharged from cars or trucks to a track hopper feeding a 2,500-lb. skip-hoist, which elevates the material 40 ft. into a small hopper feeding a 24-in. Robinson jaw crusher. This dischages through a split chute to either or both of two 75-ton timber storage-bins.

One of these bins discharges to a bucket-elevator which discharges through a selective split chute to either one of another pair of 75-ton bins. These feed through sliding gates and chutes to a Raymond high-side 5-roller mill equipped with a 60-in. Raymond exhauster fan which blows the product to a cyclone on the roof of the building. The fine dust is exhausted to a bag-house, the commercial material goes to a spout sacker, and the air is returned to the exhauster fan. A natural-gas-burning furnace can remove any moisture content up to 20 per cent. in the material going to the Raymond mill.

The second bin under the primary crusher discharges to a short belt-conveyor which feeds a Traylor 24-in. double-roll crusher if further reduction is desired. This conveyor can also discharge directly into the same elevator as that taking the product of the roll-crusher. The elevator discharges to a bin which has three discharge spouts feeding the Raymond mill bin, the roll-crusher, or the 11-ft. by 7-ft. diameter Hardinge conical mill. This mill is loaded with pebbles and discharges to an elevator feeding an Oliver separator. The "fines" go to a sacker and the "rejects" back into the mill. Any product containing iron impurities is passed over a magnetic pulley before being sacked.

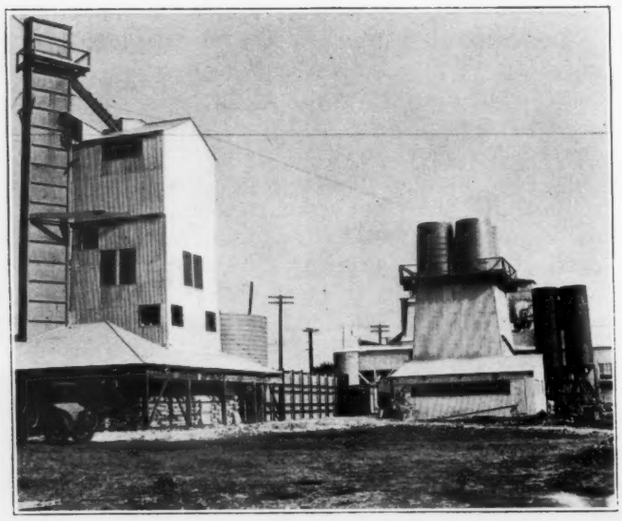
Any material containing undesirable foreign matter or impurities is fed from the roll-crusher by an elevator to a small revolving screen. The coarse material returns to the rolls, while the "fines" go to a 6-cell jig-type washer of the company's design. The product then goes to a drag classifier which discharges to an elevator leading to the mill bins. The overflow water from both the jig and the drag goes through a settling tank before passing to the city sewers.

The Raymond mill is belt-driven by a 75-hp. motor. The Hardinge mill and the Raymond blower are driven by separate 40-hp. motors through Dayton Cog-Belt drives. The roll-crusher is driven by a 25-hp. motor, which also drives three elevators

Plant No. 2 with the new drying unit under construction.

and the washer by means of a line-shaft. All sacked material is weighed on Fairbanks platform scales. Fire protection is provided by two 50-gal. Foamite buggies and a number of Pyrene hand extinguishers. Additional protection lies in the fact that a fire-department station is only two doors from the plant.

The raw materials received at Plant No. 2 arrive by truck or rail. That intended for the tube-mill plant is discharged to a concrete apron feeding a 16-in. Joshua Hendy jaw crusher. This discharges

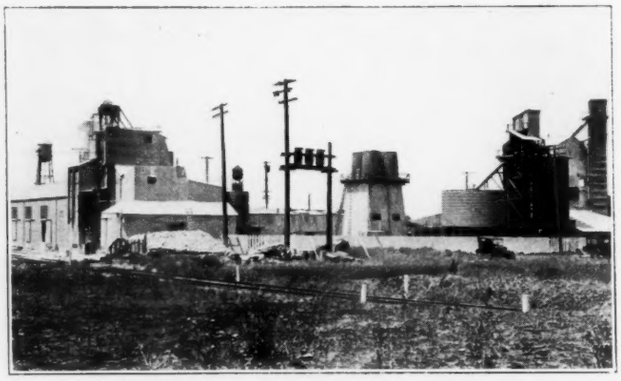


Plant No. 2 of the American Development Co.

to either unit of a double bucket-elevator on 50-ft. centers. One of these is used when the material is dry enough to be ground and the other when it must first be dried. The grinding-plant elevator discharges through a flop gate and split chute to either of two 50-ton circular steel storage-bins. Both bins feed through chutes into the Hendy 6-ft. by 18-ft. single-compartment tube-mill. Danish flint pebbles are used in this mill in any size required by the particular type of material being handled.

The tube-mill discharges to a bucket-elevator on 75-ft. centers from which the material is fed through a chute to a 14-ft. Raymond mechanical separator. This has a capacity for ordinary materials of 25 tons per hr. The finished material is loaded through a spout into sacks, while the "rejects" go through a chute back into the tube-mill.

The crusher is belt-driven by a 20-hp. motor, the separator by a 25-hp. motor, and the elevator to the separator by a 7½-hp. motor. The tube-mill is



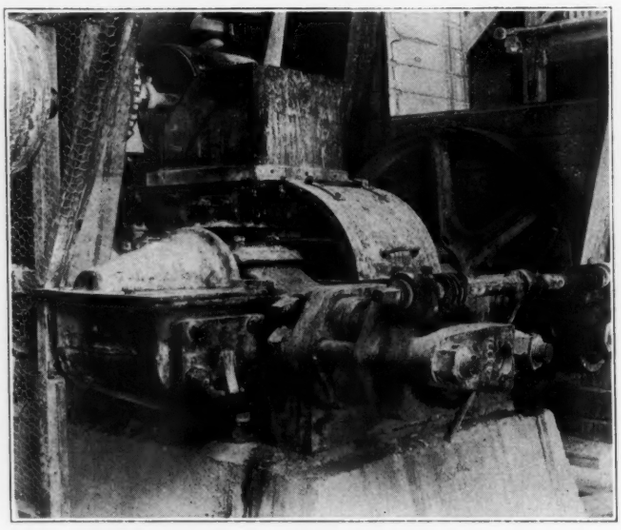
Plant No. 1 at left and, at right, Plant No. 2.

driven by a 75-hp. Westinghouse motor through Morse silent-chain drive and a friction clutch.

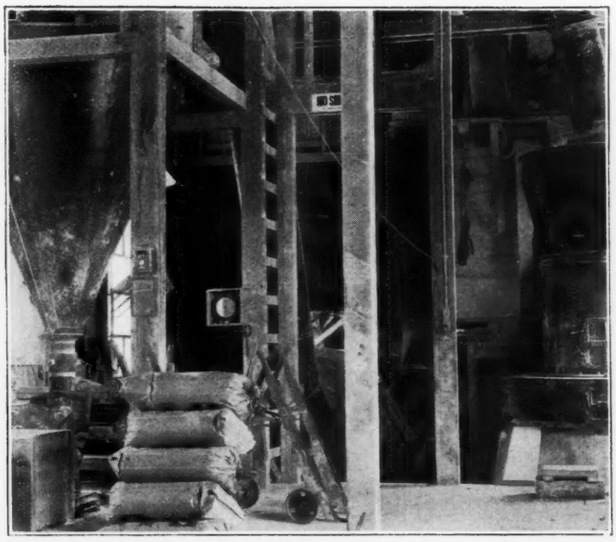
The other elevator of the double unit discharges the crushed raw material through a chute into a 200-ton circular wooden-stave storage-bin. The balance of this plant is under construction and will soon be in operation. The wet material will be fed from the bin by a screw-conveyor and elevator into an indirect-heat oven drier. This consists of an oven with a 50-ft. drier tunnel through which the material will be carried by a series of two pan-conveyors, each traversing the full length of the drier. An exhauster fan will force the heat to the drier and the used air will return through a pipe to the fan, thus forming a continuous closed circuit. A temperature of about 500 deg. F. is expected.

The last of the two pan-conveyors will discharge the dried material to narrow-gauge tram cars which will carry the material to either of the grinding plants for processing.

All the operating units, the crusher, elevators,



The 24-in. roll-crusher in Plant No. 1.



Packing spout and hopper. At right, part of the roller-mill and blower.

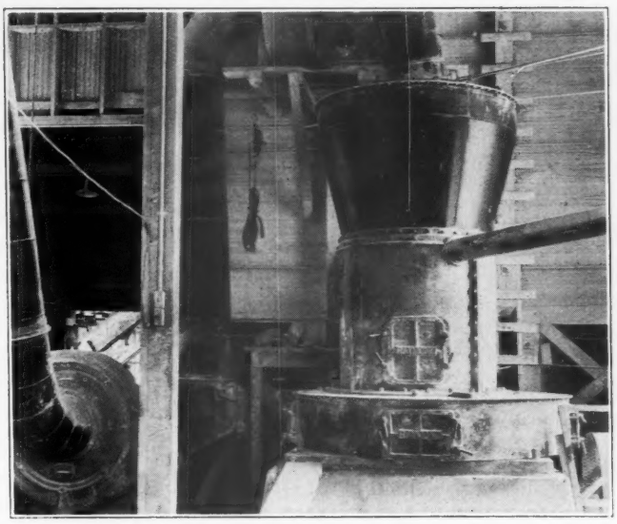
tube-mill, separator, etc., are protected against fire by a system of pipes feeding CO_2 gas to them. This gas is stored in containers near the plant with a valve-control system which allows the gas to be fed to any or all points as desired. This not only insures against ordinary fires but also provides protection in case inflammable materials are being ground.

The original sack-storage building alongside Plant No. 1 is 40 ft. wide by 100 ft. long and was at first used for all shipments as it is on the original siding to the plant. When Plant No. 2 went into operation additional storage capacity was needed. A fireproof warehouse 150 ft. long by 60 ft. wide was then built at right angles to the original one on the adjoining property line. This warehouse is so designed that it can be enlarged to double its present size, a change which will probably be necessary when Plant No. 3 goes into operation. This seems to be an excessive amount of storage space but is necessary because of the diversity of products and sizes of products and because a sufficient amount of each is kept on hand so that orders can be filled immediately. A special siding alongside this building also facilitates shipments. Sacked material is brought to this warehouse from Plant No. 2 by a covered inclined gravity conveyor.

The bungalow-style office building.

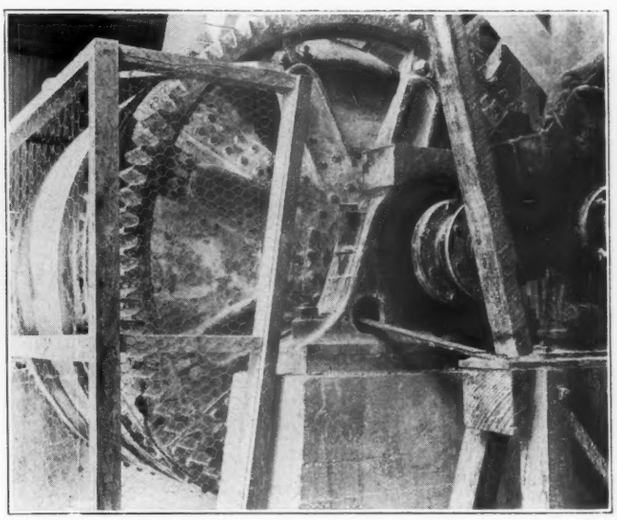
Plant No. 3, which is now under construction, is very similar to Plant No. 2 but is slightly smaller. The principal equipment includes a 4-ft. by 16-ft. Gates tube-mill and a Raymond separator. This plant is a complete unit in itself with its own storage-bins, etc. A fourth unit is already planned to be built next spring and will probably use a Raymond mill for grinding.

All buildings have concrete footings and machinery foundations, timber framework, and are inclosed with corrugated sheet metal. All elevators are completely inclosed and other precautions taken to keep all operations as safe and dustless as possible. With a few exceptions Westinghouse motors are used throughout the plant.

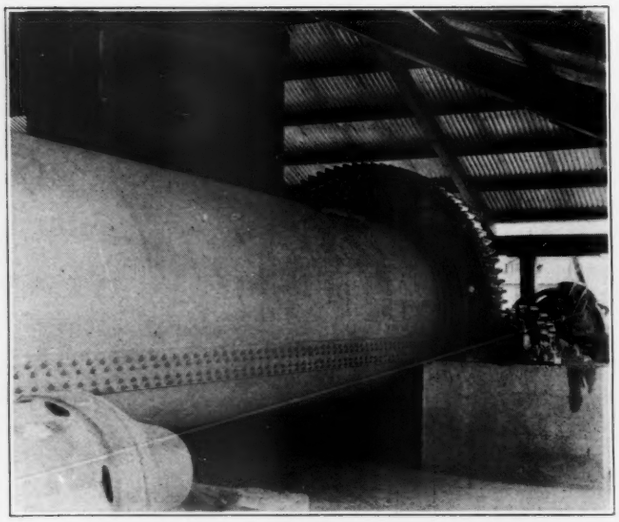


The roller-mill and blower.

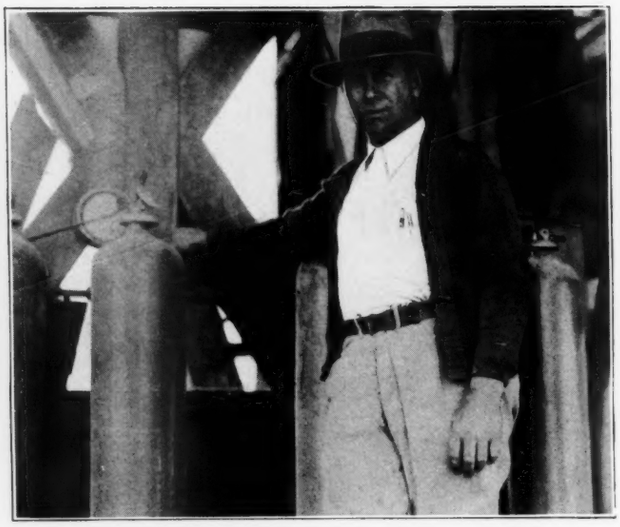
The plant has its own water supply, although city water is available in case of an emergency. A 2-plunger deep-well pump feeds four 20,000-gal. timber storage-tanks which are mounted on a timber framework. This framework is inclosed with corrugated metal, the building thus formed being used as a machine-shop and for storing equipment and spare parts. The machine-shop is completely



A close-up view of the conical mill.



The 18-ft. tube mill which operates in Plant No. 2.



Supt. Newlen at controls of the CO_2 gas fire-protection system.

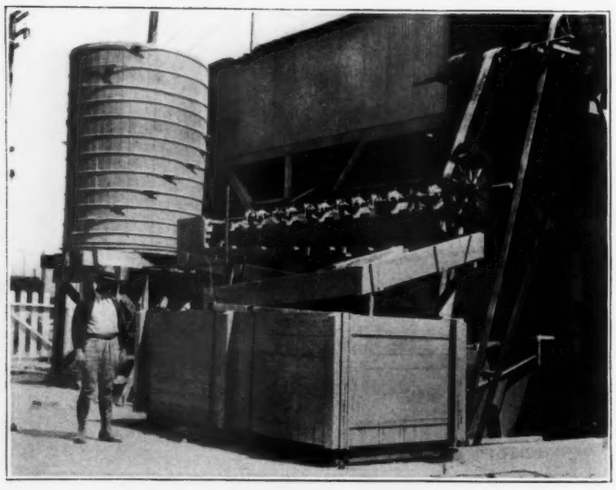
equipped with a lathe, drill-press and other necessary equipment. All elevators, conveyors and much of the other minor equipment used in the plant is made here.

The American Development Co. was originally formed for the purpose of developing mines in Nevada and selling the crude ores. It was, of course, only a natural step to go into the business of grinding and marketing its own products as well as those from other sources. The company owns and operates two barytes mines at Carlin and Eagleville, a tungsten mine at Rawhide, an alunite mine at Sulphur, a bleaching-clay mine at Churchill, a feldspar mine near Reno, and a volcanic-ash mine west of Carlin, all in Nevada. A number of other minerals are also purchased in the raw state from other producers and marketed under the company's brand.

A list of the materials ground at this plant to date is appended. It is continually being added to and the plant is now equipped to handle at least fifteen other materials for which there has as yet been no demand.

Materials	*Uses*
Fire brick	Furnaces
Barytes (1, 2)	Paint pigment, glass, paper, etc.
Bauxite	Alum and acid trades
Silica flour	Steel, ceramics, glass
Alunite (2)	Fertilizer
Quicklime	Plaster, chemicals, deodorant
Putty lime (1)	Putty
Whiting (1)	Paint filler, plaster, paper, wallboard
Magnesite	Flooring
Hi-temperature cement	Furnaces
Chemodust (1)	Insecticide, fungicide
Belgian chalk	Paint filler
Bleaching clay (1, 2)	Bleaching and filtering vegetable and lubricating oils
Volcanic ash (1)	Soap
Porcelain	Nitrogen fixation
Soapstone (1)	Paper and concrete filler, temperature-control
Sodium silicate	Chemicals
Sodium sulphate (1)	Chemicals
Dolomite	Steel flux
Bentonite (1)	Collodial uses, water filtration
Fire clay (1)	Fire retardant
Roofing clay	Roofing
Pyrites	Glass trade
Bluestone	Chemical
Tungsten (1, 2)	Steel trade
Chrome	Steel trade
Feldspar	Ceramics
Phosphate (1)	
Blanc Fixe (1)	
Calcium carbonate (1)	
Fluorspar (1)	
Witherite	
Manganese	

(1) Principal products sold under the company's brand.
(2) From the company's mines.



Jig and settling tank used for washing material.

The main office of the company is at the plant at 836 Gilman St., Berkeley, Cal. The officers of the company are: A. R. Morrow, president; H. T. James, chairman, executive committee; V. H. Carter, general manager, and Miles Cantelon, secretary and treasurer. A. D. Newlen is plant superintendent and Ed Benane is in charge of all of the company's mines.

Making the New Employee a Safe Worker Is the Foreman's Obligation*

By JACK DEMPSTER
Canada Cement Co. Ltd., Port Colborne, Ont.

YOU wanted another man, and you have him. More than likely his vital history has been taken in the employment office, and a few salient facts were given you, but he has been turned over to you. Now what?

In the old days he was told he had certain duties to perform, a pick and shovel were given him, or he was placed at the machine he was hired for and told to go to work. It is a far cry from then until now; someone started the agitation that "foremen are responsible for the personal injuries of their men," and if that is true, one large burden has been laid upon our shoulders. Evidently we have to take it, so we'll just look in the mirror and try and find what we have to do and how we are equipped to do it.

"John, take this man!"

It starts there, but we all feel like demurring when someone says he is to be our responsibility. I believe we are using a word here that is sometimes misunderstood. None of you will agree if I say that we are to "blame" for an accident caused to one of our men, but if I say that we are "in charge" of our men and their actions while on the job, it will sound better. To illustrate: I have in mind a plant that operates with some of the most powerful machinery known, which has not one foreman on the job from 5:30 p.m. to 7:00 a.m. and yet this is a 24-hour plant. In that organization the foremen are held accountable for all accidents to their men because they have charge of them, not like the visitor who went into an office and asked the office boy, "Who is the responsible man here?" The boy answered, "If you mean, 'Who gets all the blame?' that's me!"

In this hard-boiled age of competition, I wonder if we all realize just how the average new man on the job feels? Nearly always he is a stranger to the work, the men, the officials and the production methods. Here is where the real safety foreman steps in. It is in his power, to a great extent, not only to remove the new man's apprehension and timidity, but to start him off on the right foot regarding the plant's accident-prevention policies. The foreman has, then, a number of duties regarding this man, and you will agree that if they are conscientiously performed, we will have done our best to create a friend, an efficient employee and a safe worker.

First, we must gain his confidence. When you contemplate the purchase of a car, you find out all you can regarding its capabilities to warrant dependence upon it. You want to be sure that when an emergency arises, the car will rise to the task expected of it, and after you have been driving your car for a while you are so familiar with it that, as we have heard often, you hesitate to trade it in because you know the old one so well.

You take a new man under your jurisdiction, and thereby render yourself responsible for the work he performs. As far as you are concerned, in the beginning, you have an unknown factor. Probably not at once, but certainly as soon as possible you can make it a point to have a talk with him. Forget the plant and his duties for a few minutes and get into his domestic life. You know that a friend is a better asset for you and your plant than one who is merely working for wages. It will be no hardship on your part, and may not even appear to be of great importance to you, but if you can get him to tell you of his wife and children, if he is married; of his dependents if he has any, and of his home life, his ambitions—get him even to tell you about the operations he has had. Can he play ball? Is he a musician? If he is of the non-English-speaking races, get him to tell you a little of his own country and its customs. Can you realize for a moment just what all this means to the new man? You know perfectly well that you want a man who will be working just as hard and efficiently when you are away from him as when he knows you are watching him. The real foreman of today isn't riding about on a high horse, and if you are one of those who will be greeted with, "Mornin', Mister Tom!" "Good Morning, Dick," or "How goes it, Harry?" by the men under you—well, there isn't very much the matter with you.

In the early days of organized accident-prevention work, one of the hardest obstacles to overcome was the suspicion of the rank and file. So many men thought the company had an ulterior motive and wished to avoid accidents purely for economic reasons. As the work presented so many varied problems, and so much ground work had to be done, it was quite a while before a whole organization could be sold on the idea. By gaining the open-minded confidence of your new man, you can present safety policies to him in a manner that he will never forget. Don't make the mistake of thinking also that because a man talks English imperfectly that you have to talk broken English, too. See that he understands you, but remember that he looks up to you. You have a position to maintain and he will try to learn from you, providing of course that you don't kill the whole thing by an assumption of superiority. Every man—new man or old employee—has a certain amount of pride and if you wound that you will do incalculable harm. The new man wishes to emulate you and those above him. If his aspirations are guided in the right direction you will be achieving your object.

The story is told of a dry-goods dealer of Hebrew extraction, who sacrificed considerable in order to

* An address delivered at the 1931 National Safety Congress.

send his son to college. In ccurse of time the boy wrote home to his father and each time he used the college note-paper. On these letter-heads appeared the names of the college professors, with their degrees after the names—B.A., B.S., Ph.D., and so forth. On his first vacation the boy returned home and after a while the father said: "My son, I see you used the college note-paper for your letters, which was very good. But what do all the letters mean that appear after the professors' names?" The son then explained that they stood for the accomplishments and qualifications of the teachers. Some time after the boy had returned to school, the father had a sign painted and hung over his store. On his boy's next visit home he noticed it—"Isaac Cohen, F. F. F. F. F." He became very curious and said: "Father, what do those five 'F.'s mean after your name?" "My boy," said the old man, "they stand for my accomplishments and qualifications—two Fires and three Failures."

No matter how experienced a man may be, he doesn't know it all. Your methods may be vastly different from those in vogue at other plants. As a foreman you are also a teacher. If you have gained the new man's confidence he will learn from you, and straightway you must embark upon your policy of safety education. When you went to a strange school, the teacher did not take your word as to the extent of your knowledge. He placed you under observation until he found out what you did know.

We are fond of saying, "teach him to be safe and he will be a good workman," so go at it the right way. Never mind that "sob stuff" with the new man. It used to be the procedure to point out in pathetic terms a picture of the heart-broken widow and fatherless children—bereft because daddy stepped on a nail and didn't get first-aid treatment. For a long while we filled the heads of our new men with visions of cripples selling lead pencils, and a procession of wheel chairs from here to back again, because the victims tried to put a belt on a revolving pulley, or climbed up a rickety ladder, and so on. The fallacy of this system became apparent and was shown one day when one of the safety-committee members on our plant came into the office and said: "Here! Something's all wrong with this safety stuff. I am so full of pictures of the hospital that I can not walk along the sidewalk in confidence for fear I might trip over a match, and I dare not climb, or run a machine in case I may be made to occupy a stretcher." Industry soon discovered the same fact. Never mind talking about the billion or more dollars that accidents cost America—your man can't comprehend a billion, neither can you, but he sure can grasp the fact that his wages will be two dollars and sixty-six cents, instead of four dollars a day, if he gets hurt. Let him see that it is bad business to suffer unnecessary pain; that he is imposing a penalty upon others when his wife has to suffer because of him, and that it is not laid down in the laws of employment that a child must go hungry because a man gets hurt. Teach the new man that all personal injuries can be avoided. That is a strong statement, but you know it is true even though some of you won't admit it. There are two words, used to describe a state or condition, that I believe have done more for accident-prevention than anything else. They are "Safety-Mindedness." That is what you want to teach the new man. Machinery must run and belts will come off and break; the blast furnace will develop weak spots, insulation will wear off wires and nails will always be left protruding by someone, but that inward consciousness of a policy of self-preservation will compel a man to give first consideration to his life and limbs. When you can make him realize that it is unnecessary to have an accident, that it is poor business, that the company regards it as inefficiency on someone's part and that he, himself, will suffer when there isn't the slightest reason why he should do so, then you are maintaining your own position and you have a better worker. He knows that you are his friend.

Be sure that your new man thoroughly understands the motive for your safety warnings and teachings. Don't let him alone, undecided, but make a safe worker out of him even in spite of himself. I am reminded of a picture I once saw in a magazine. It had no title, and a prize was offered by the publishers for the most appropriate title sent in. It was a picture of a pretty ballet dancer sitting on a large rock by a country roadside. She wore the customary ballet costume and was very attractive, with one of those "I want to be loved by you" looks in her eyes. Standing on the road, looking at her, was a Puritan preacher, in Quaker garb—long coat and wide-brim hat. His eyes expressed longing. The winning title sent in was this: "Ah, Brother Piety, Which Shall It Be: Onward Christian Soldier, or, Abide with Me?"

You are going to fail in your prime duty—you will have no success with your new man—if you fail thoroughly to impress him at the beginning. Think what an opportunity you have to add to this world's happiness. You have a machinist, an oiler. a laborer or a kiln attendant given you and you must let him know that you are sincere. For a time he will be puzzled with the mystery of it all. "Why should a foreman care whether I get hurt or not, unless he gets something out of it?" But as he sees the light of earnestness in your eyes, detects the solicitude in your voice, he will come to realize that you are only a human being, even as he; that you, too, have someone who shares your joys and sorrows. He will know that you, too, are not forgetful of the parents who brought you into the world, and because of your impressiveness he will feel that no chance is worth jeopardizing the privilege of losing his rough fingers in the curly head which rests itself upon his knee. See that he knows that if there are such things as love, wife, children and happiness, it requires all his faculties to enjoy them, and nothing is worth while if it will tend to injure those faculties. See to it that your new man detects no hypocrisy in you. If he thinks you are not in earnest and you fail to impress him, then you have responsibility indeed!

(Continued on page 59)

A Theory Regarding the Silicates in the Chemistry of Cement Formation*

By Dipl.-Ing. R. ZOLLINGER

THE constantly-increasing demands which the user of cement makes of this material, as in the interest of the development of the quality of cement he should and must, have raised the cement industry from an originally purely empirical method of manufacture to a scientific basis. In that way cement chemistry arose as a branch of silicate chemistry.

In order to be able correctly to understand the conditions in the formation of cement we must first get a clear idea of the silicates. The basic material for the production of cement is the material which we term clay substance. It is found in nature in the materials loosely known as clay, or partially mixed with limestone constituents, known as marl. These clays are to be identified as the semielastic decomposition-products of the original rocks. Varying with the stage of decomposition, the clay substance contains the minerals of the original rocks in part still undecomposed, in part more or less broken down. Along with the quartz as pure silica we can recognize, as original-rock minerals, feldspar, mica, and hornblende. In the case of the last three we are dealing with silicates.

The silicates can be divided into three groups: (1) the metasilicates, (2) the orthosilicates, and (3) the silicates of the complex sesquioxide types. If we consider the chemical composition of the minerals we are dealing with, it seems as though there were a variation without rhyme or reason. But if we classify the minerals in such a way that we consider not the individual chemical elements but rather groups of chemically-related elements, we obtain comparatively simple figures with only three components: (1) the SiO_2, (2) the group of monovalent and bivalent elements of type MO and M_2O, respectively, and (3) the group of trivalent elements of type M_2O_3. Table I shows the arrangement of the rock minerals in the three classes of silicates. In this manner the minerals can also be expressed conveniently in the three-component diagram, computing the MO and M_2O as CaO and the M_2O_3 as Al_2O_3; thus we obtain the picture presented in Fig. 1. Within the delineated area, then, lie the different mixtures of the minerals, as they occur in the clay substance. Those of importance for cement manufacture, on account of quantity, are only those represented in Fig. 2.

Now the production of cement consists in decomposing the minerals and building new chemical compounds. In this we imitate a process which the chemistry of the laboratory has known for a long time—fluxing in molten soda. But in the factory process of cement production we take not soda, but lime. This fluxing or decomposing takes the same course as the decomposition of the original minerals in nature, in that simple silicates are formed from the high-molecular sesquioxide-silicates. This process shows itself outwardly in an increasing solubility of the minerals of the original rocks and, because of this solubility, constituents of the minerals disappear, being taken into solution and carried away by the water. Nature has plenty of time and accomplishes this mineral decomposition in millions of years, while we must attain the same result in a short period of time. For this reason we need more powerful reagents. Thus, when decomposing minerals in the laboratory, we use soda in connection with heat and, in large-scale industrial decomposition which is the basis of cement manufacture, lime. In this case, as in the first, the degree of decomposition shows itself through an increasing solubility, so that at the end of the process the entire mixture of minerals exists in reduced form, that is, simple silicates have been formed from the complex silicate compounds.

This decomposition process would be completed at the point where all the complex silicates have been reduced to simple silicates. In Fig. 3 the line $MO.SiO_2 - MO.M_2O_3$ would indicate the fully completed reduction. But the production of cement is

* Translated from *Zement* 20:738-741, Aug. 6, 1931

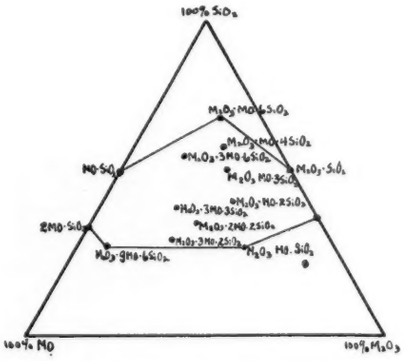


Fig. 1.

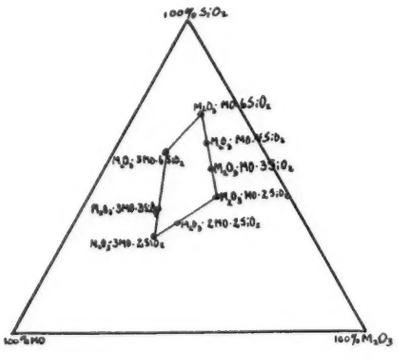


Fig. 2.

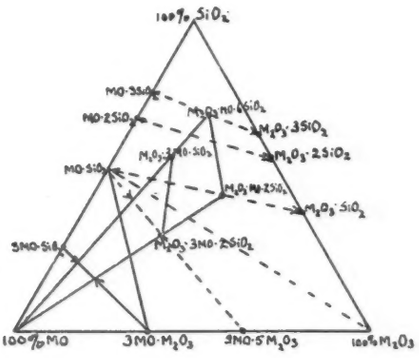


Fig. 3.

not completed with the attainment of this decomposition, for this is merely a means to the end and, thus, only a phase of the process of manufacture.

In the production of cement, in fact, we not only decompose but also compose again. This recomposition has as its purpose the creation of compounds supersaturated with lime, in which the hydraulic properties of the cement are contained. Thus we must introduce a quantity of lime greater than needed for the fluxing, so as to attain supersaturation. What takes place then is as follows: The lime, or, generally speaking, the compound of type MO, has chemically a greater affinity for SiO_2 than the compound of type M_2O_3. If the stable metasilicate $MO.SiO_2$ has been formed, then further addition of MO will next separate the silica from the M_2O_3 so as to be able again to form $MO.SiO_2$. Further addition of MO even reduces the role of the sesquioxide, and then compounds of the type $MO.M_2O_3$ result, in which, thus, the M_2O_3 must take over directly the functions of the SiO_2. If we increase the quantity of MO still further, then the genuine supersaturation of MO takes place, which theoretically can be continued to the types $3.MO.SiO_2$ and $3.MO.M_2O_3$—the types which we strive to attain as the ideal case in cement.

If we look at Fig. 3, we know as a result of what has been said that the best cements within the triangle 100 per cent. $MO - M_2O_3.MO.6.SiO_2 - M_2O_3.MO.2.SiO_2$ are to be found on the line $3.MO.SiO_2 - 3.MO.M_2O_3$. In this way we arrive at the guiding principles for the cement chemist.

Cement, then, in its ideal form consists of the two components $3.MO.SiO_2$ and $3.MO.M_2O_3$. The actual quantity of silicate in proportion to the quantity of aluminate or ferrate depends on the raw materials. Recent clays, which still contain a good deal of $M_2O_3.MO.6.SiO_2$, that is, unreduced feldspar, will normally yield cements whose silicate content is quite preponderant. Cements of this category are thus to be sought in the direction of the line 100 per cent. $MO - M_2O_3.MO.6.SiO_2$ (Fig. 3). In line with what has been said an invariable cement substance, which a great number of different investigators are pursuing, is clearly out of the question. If we wish to express cement or cement substance unreservedly in a formula, this must take the form:

$$x.\ (3.Mo.SiO_2).y.(3.MO.M_2O_3),$$

in which x and y are dependent on the raw material or on the admixtures used.

In order not to complicate the picture, there has been thus far no mention of admixtures. It has been assumed that the raw materials occurred in a form which made possible the decomposition and recomposition of cement substance by the simple addition of MO. But, it is not often possible to achieve a complete neutralization of the elements of the clay-substance minerals by simply adding MO—that is, in the case of cement manufacture, limestone—and it is necessary to bring either the M_2O_3 group or the SiO_2 into practicable proportion by varying additions. Herein lies the chief art of the cement chemist, and on the correct proportioning depends the quality of the cement produced. As limiting formulas of good cements we must always strive for cements of the formulas:

$$6.(3.MO.SiO_2).1.(3.MO.M_2O_3)\ \text{to}$$
$$2.(3.MO.SiO_2).1.(3.MO.M_2O_3)$$

It is essentially the same whether the two components silicate and aluminate are present freely mixed with each other or are combined in the form of complex compounds.

According to their chemical composition the cements would be of the following natures:

$$6.(3.MO.SiO_2).1.(3.MO.M_2O_3) =$$
$$21.CaO.R_2O_3.6.SiO_2 =$$
71.21 per cent. CaO
6.34 per cent. Al_2O_3
22.45 per cent. SiO_2
Lime modulus = 2.47
Silicate modulus = 3.53

$$2.(3.MO.SiO_2).1.(3.MO.M_2O_3) =$$
$$9.CaO.R_2O_3.2.SiO_2 =$$
69.37 per cent. CaO
14.05 per cent. Al_2O_3
16.58 per cent. SiO_2
Lime modulus = 2.26
Silicate modulus = 1.18

TABLE I

Metasilicate:	
$MO - SiO_2$ ($M_2O - SiO_2$) $M_2O_3 - 2 - SiO_2$	Enstatite, hypersten, Wollastonite
Orthosilicate:	
$2 - MO - SiO_2$ ($2 - M_2O - SiO_2$; $MO - M_2O - SiO_2$) $M_2O_3 - SiO_2$	Olivine Andalusite
Monosesquioxide-silicate:	
$M_2O_3 - MO$ (M_2O) $- SiO_2$	Lime mica
Disesquioxide-silicate:	
$M_2O_3 - MO$ (M_2O) $- 2 - SiO_2$ $M_2O_3 - 2 - MO - (M_2O) - 2 - SiO_2$ $M_2O_3 - 2 - MO - (M_2O) - 2 - SiO_2$	Anorthite, biotite, alkali-mica, kaolinite
Trisesquioxide-silicate:	
$M_2O_3 - MO$ (M_2O) $- 3 - SiO_2$ $M_2O_3 - 3 - MO$ (M_2O) $- 3 - SiO_2$	Garnet
Tetrasesquioxide-silicate:	
$M_2O_3 - MO$ (M_2O) $- 4 - SiO_2$	Leucite, alkaliaugites und Hornblendes
Hexasesquioxide-silicate:	
$M_2O_3 - MO$ (M_2O) $- 6 - SiO_2$ $M_2O_3 - 3 - MO$ (M_2O) $- 6 - SiO_2$ $M_2O_3 - 9 - MO$ (M_2O) $- 6 - SiO_2$	Orthoclase, plagioclase, albite

Augite, hornblende

Oligoclase, Andesine, Labrador, Hyalophane, Baryte feldspar

Both cements have their defenders and are actually produced. The cement $6.(3.CaO.SiO_2).1.(3.CaO.R_2O_3)$ is known as Velo cement according to patents of the Smidth company, while the cement at the opposite extreme is known as Kühl cement. Between these two cements naturally lie a great variety of possibilities. In this connection it is striking that the quality of the intermediate cements is in no case equal to that of the two extremes, so that it is easy to assume that certain complex combinations take place within the silicates and aluminates, which in a certain measure can proceed harmoniously only in the extreme cases and that right in this harmonious adjustment lies what essentially gives cement its

quality, and which cement chemistry has not been able perfectly to comprehend even up to the present time.

These considerations extend, of course, only to the pure cement substances. In most cases, however, extraneous materials are associated with the raw materials and must be taken into consideration. Therefore no cement chemist must fail to take these materials into account in his computations; only then can he comprehend and account for possible variations.

In general, incorrect constituents show themselves easily by means of the insoluble and the loss on ignition. Much insoluble indicates an excess of SiO_2, so long as incomplete reaction has not been caused by underburning. A high loss on ignition points to an excess of CaO or to a too high SO_2 content. A large remainder to 100 in the chemical analysis also gives cause for thought. Aside from magnesia, which is ordinarily determined positively and taken into consideration, this remainder is caused primarily by alkali. The best cement will no doubt be that in which the components $SiO_2 - R_2O_3 - CaO$ together approach 100 and in which the relation of the components to one another comes reasonably near to the mentioned lime or silicate moduli. In the evaluation of cements we should therefore seek a rigid limitation of the foreign substances within the standard specifications. In this manner a bar is also best placed against the frequent practice of thinning cements by means of foreign admixtures.

The New Employee and Safety

(*Continued from page 56*)

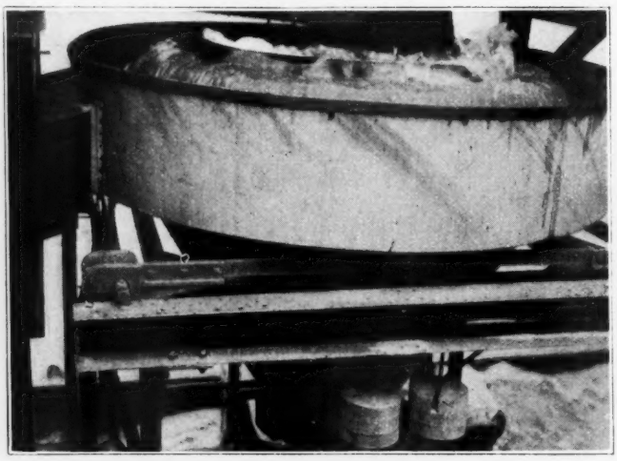
As we have grown in knowledge, our machinery made more intricate, our methods more scientific, so has man at his finger tips command of more power than our fathers dreamed of. Can you guide those finger tips and, in doing so, impel your new man to follow you with confidence? Mr. Foreman, if you can't impress your new man with the full value of that which you have to sell, he can not detect sincerity in you. In the accident-prevention phase of manufacture, there is a new conception as between master and man. The foreman no longer looks upon his men as mere creatures of flesh and blood who are subservient to him. The real foreman will look beneath the accidental conditions of birth, education, environment or nationality, and will catch a glimpse of a brother worker.

I have said that the foreman must gain the confidence of the new man; that he must teach him and that he must impress him; but these three requisites must be followed up—you must supervise him. Now, in that last quality the true safety foreman comes to light. Suppose a member of your family were ill and you call in a doctor. The first thing he does is to seek out the source of the trouble; he asks questions and he gains the confidence of the patient. He then lays down a set of rules, tells the patient or nurse what must be done and impresses them with the fact that, not only does he, the doctor, know exactly how to handle this particular case, but that the patient is going to recover. We know and have been taught that a great deal of a patient's chance for recovery depends upon the coöperation of the patient himself—therefore he must be impressed by the physician. But supposing after all this, the doctor said good-bye, pocketed his fee and never bothered about the sick patient again—would you feel that he had completed his job? If the patient were seriously ill, wouldn't you say that the physician should have paid other visits, or at least supervised recovery—that he should have noted the condition of the patient from time to time? Of course you would, and no matter how much the foreman thinks he has convinced the new worker, he must check up on him now and again with just a word or two of encouragement or caution at the right time.

In the majority of plants it has not been found practicable for the whole organization to stop work and attend safety meetings very often. Nearly always we find a committee, composed of foremen, who can relay instructions to their men individually, to be most effective. We know that oftentimes a half a dozen words, given in what may not be precise grammar, by a foreman to his men, may carry more weight than a half hour's talk by the general manager. Our duties are thus clearly set forth. As a go-between, we must carry our men along and, not only see that the demands of production are satisfied, but that Tony Angelo or John Smith does not endanger his ability to produce, and that he understands that his first thought must be of safety, both for himself and his fellow workers. Supervise him? Yes, but supervise him intelligently. Let him know that not only is he part of the job, but that the company is relying on him. This work has made us all part of a big fraternal organization. If a safety competition is under way and a safety record exists that we are all proud of, don't forget that a slip on the part of the humblest worker can wreck the achievement just as surely as one by the manager.

I heard a story once of a foreman who bossed a gang of Italian laborers. They were all new men and were engaged for pick-and-shovel work. This foreman took the gang outside a building and into a large yard and, pointing to the ground, said, "Dig here." They dug down two or three feet. Then he stopped them and said, "Dig over there," pointing to a new place. They dug down again for a while and, without any apparent reason, he stopped them again and told them to dig in another place. This was repeated five or six times, and at last one of the gang, who were by now muttering to themselves, said: "What-a da hell; maybe you crazy. Dig-a here—stop; dig-a there—stop. All-a time dig like hell and stop. What's-a da mat?" Then the foreman did what he should have done in the beginning. He explained that the office had mislaid the drawings of a long-buried pipe-line that ran through the yard somewhere, and that they just had to find that pipe. Well, after that, the men's jobs seemed intelligible to them. They knew what they were doing and why they were doing it and they went to work with a will.

View showing construction and feed of classifier.



One of the sand classifiers in operation.

Original Production Methods Mark This Gravel Plant on Kansas River

Semi-Portable Operation Offers Some Novel Ideas in Dredging and Processing Material

ONE of the most interesting sand-and-gravel operations in the middle West is the new plant of the Kansas Sand Co. at Topeka, Kan., which went into operation early this summer. Like most other plants in this section, it is a simple affair using stationary screens and sand cones and seemingly offering little opportunity to any operator for applying any originality in its design or construction. Actually, however, this plant has many original methods of doing things which combine to make it one of the most efficient and economical operations in the state. Many of these features, most of which are described and illustrated in this article, were designed by Otto Kuehne, Jr., president of the Kansas Sand Co. Mr. Kuehne has had many years of experience in this locality, having been a sand-and-gravel producer for more than 10 yr.

The plant is located on the north bank of Kansas River less than 1 mi. from down-town Topeka. Like most other plants in the state it is a dredging operation and draws its material from the bed of the river which is constantly replenished from deposits further upstream. Frequent floods also bring down more material and a dredge can often operate an entire season without changing its location more than a few hundred feet. These floods also constitute a menace because they come unexpectedly and sometimes raise the river level from 10 to 15 ft. in a few hours.

The dredge at this plant is at first glance similar to many other dredges used in the sand-and-gravel industry but a closer inspection reveals many unusual features. The dredge hull is of timber and supports only the weight of the dredge pump and other equipment necessary to its operation. The 65-ft. Eagle-Swintek screen-nozzle ladder is mounted on two steel boats, each 82 ft. long, 6 ft. wide and 4 ft. deep. Each boat is composed of four steel pontoons connected by steel plates at the top, the bottom and the sides. These boats are hinged to the dredge hull in such a way that none of the weight of the ladder is on the dredge. The ladder is supported near the intake end by an A-frame carried on the steel boats. A 1-drum English hoist raises and lowers the ladder by means of two 4-sheave blocks at the A-frame. One of the most dangerous jobs on a dredge, that of oiling the upper block, is eliminated by the use of an oil-line connected to a small electrically-driven oil-pump on the dredge.

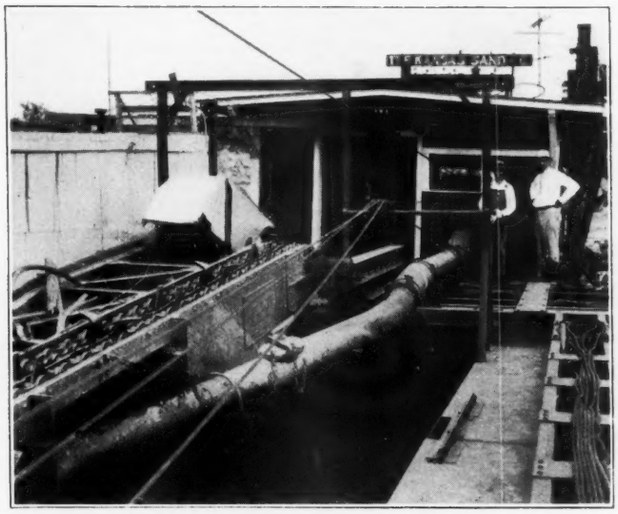
The hoist is driven by a 20-hp. motor and the ladder by a 15-hp. motor, both General Electric. The dead-man line and the two shore lines, which hold the dredge in place in the swift current of the river, are operated by a 3-drum Clyde hoist driven by a 40-hp. Waukesha gasoline engine.

This installation is the result of an experience which once almost caused the loss of the dredge. Kansas River is subject to sudden rises which sometimes threaten to tear the dredge loose from its moorings and often break the power connection to the shore. The use of a gasoline engine in this case makes it possible to bring the dredge safely to the shore regardless of conditions.

The 8-in. Amsco dredge pump is belt-driven by a 150-hp. General Electric motor and is primed by a 4-in. centrifugal pump. A trap valve on the discharge side of the pump prevents backing up of the load in case of power failure. The controls are so placed that the dredge man can operate all

the equipment without moving from his post. A telephone connects the dredge with the plant.

The pipe-line from the dredge to the shore is supported on pontoons of a type originated by Mr. Kuehne. Each pontoon has two floats made from Armco 12-gauge corrugated steel culvert pipes, 36 in. in diameter and 16 ft. long. The upstream end of each float is cut back from the top to the bottom at an angle of 45 deg. and the downstream end is perpendicular. Both ends are closed with ¼-in. steel boiler plate welded watertight and reinforced with 2-in. angle-iron cross braces. The riveted seams of the culvert pipe are electrically welded further to insure against leakage. Two screw-plugs, 4 in. and 1 in. in diameter, located near one end of each float, alllow them to be submerged into place under the pipe-line. A timber framework connecting the pontoons is fastened to the pontoon framework with steel pins, which can be easily removed when any changes are to be made to the dredge-line. According to Mr. Kuehne, this type of pontoon is very economical to make and easy to manipulate and the flat sloping upstream ends allow driftwood to slip under the pontoons, thus eliminating any possibility of the formation of the drift jams which are a constant menace to many river-dredge operations during periods of high water.



The dredge with screen-nozzle ladder in raised position.

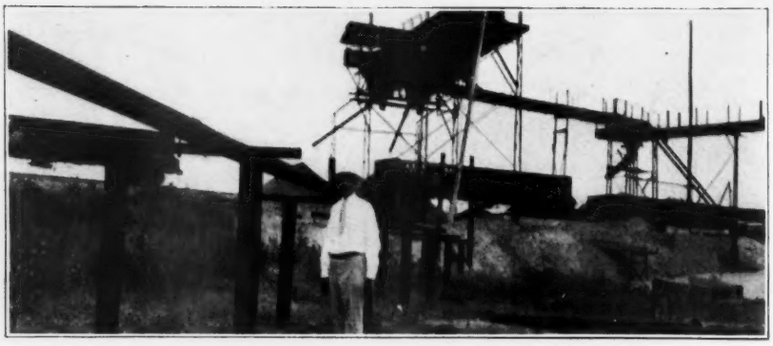
A view of the flume showing gate used to direct flow to cone.

The method used in connecting the floating line to the shore line is also worthy of mention. The last pontoon has an A-frame connecting it with a concrete post on the shore, where it is firmly imbedded in solid ground. The post consists of a steel barrel filled with concrete. A steel pin is inserted in a pipe which is imbedded in the concrete in such a way that the pin can be raised any amount up to 8 ft. above its lowest position and still serve as an anchor to the A-frame. The A-frame is arranged to allow horizontal movement of the pipe-line while the swivels at both ends of the A-frame allow for a variation in river level of at least 15 ft. without stopping operations. When, on rare occasions, the river raises beyond this point, the pipe-line is disconnected. Two flexible couplings and a short piece of pipe furnish the necessary flexibility for the pipe-line at this point.

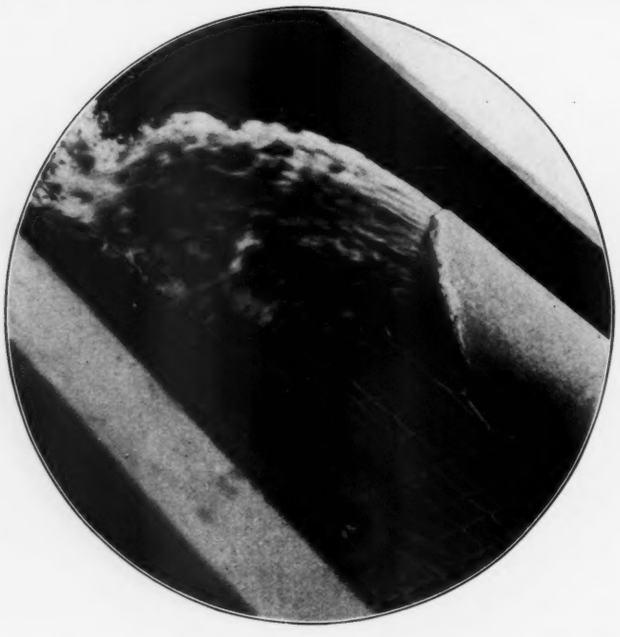
The shore line also is supported in an original manner. All pipe joints are welded and the line itself is welded to its supports in such a manner that it can readily be broken loose and moved when

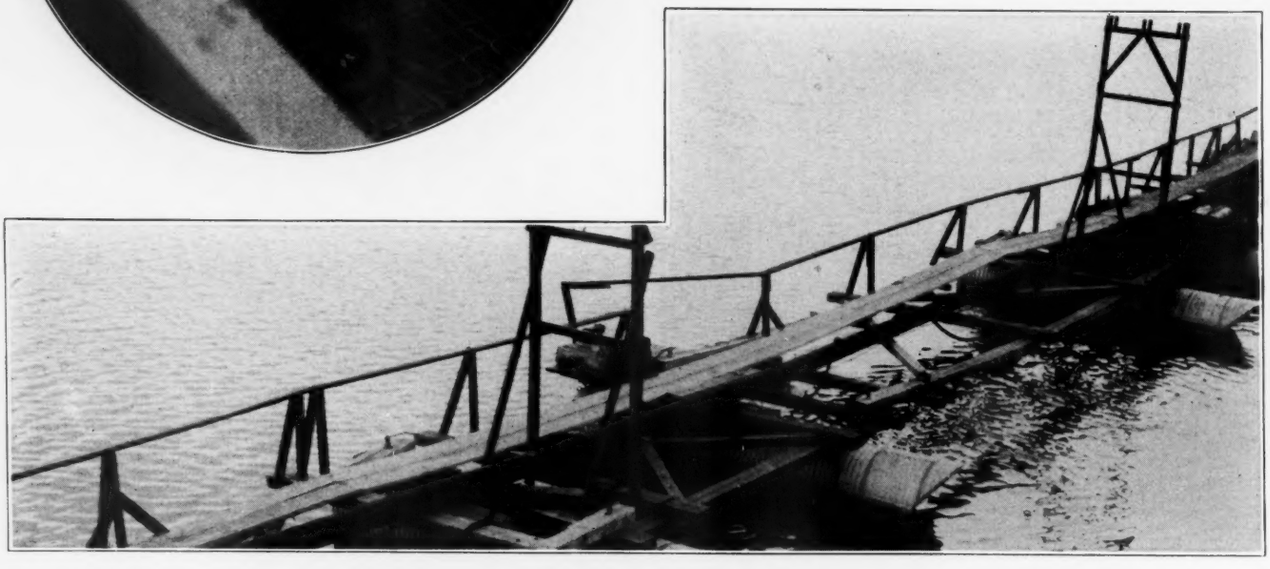
Placing spacer board preparatory to making change of screen.

Spacer board in position allowing the screen to be replaced.

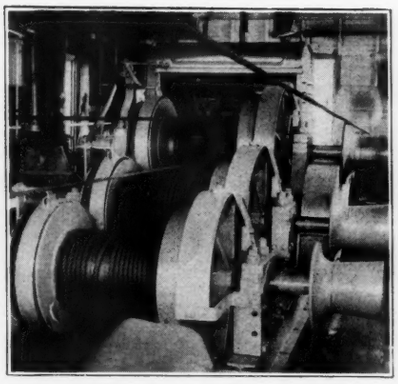


Above—The plant of the Kansas Sand Co. *Left*—The pipe-line from the dredge is supported by frames made from discarded piping. *Below*—Gasoline crane loading truck from stockpiles. *In Circle* — Discharge from dredge line to stationary screen at the shore plant. *Bottom*—View showing unusual construction of the dredge-line pontoons.

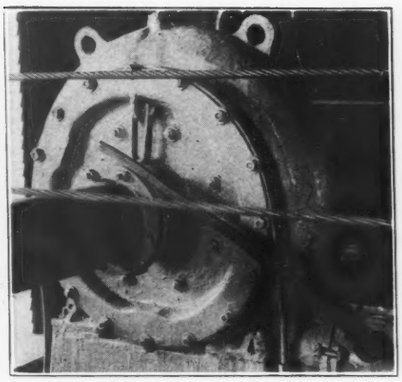




Operator at controls of the hoists on the dredge.



Three-drum hoist which handles the shore lines.



Close-up view of the 8-in. centrifugal dredge pump.

desired. The supports consist of two pieces of worn-out 8-in. dredge pipe set about 3 ft. deep in the ground with a crossbar of smaller pipe lightly welded to them.

The dredge-line is at present about 300 ft. long with a head of 63 ft. It discharges at the plant to a 6-ft. by 10-ft. gravity grizzly with a slope of 45 deg. The pipe is parallel to the grizzly at its discharge point. The grizzly has four wire screens so that any driftwood not removed by the first deck will float off on one of the other three. These screens have 2-in., 7/8-in., 1/2-in., and 1/4-in. mesh cloth, respectively, from the top to the bottom. A door on one side of the grizzly allows any of the screens to be taken out and replaced on a moment's notice without disturbing the other three. Each screen slides into place in slots in the frame of the grizzly. At present all material over 7/8 in. in size is being wasted, but bins will be installed this winter for the larger stone.

Close-up view of the plant showing details of construction.

The material under 7/8 in. in size is discharged on a 16-ft. by 25-ft. spread table which has a slope of 1/4 in. in 1 ft. This table is divided by a board which splits the material into two equal streams. Each stream is discharged over a stationary sloping screen 8 ft. wide and 2 ft. long at the end of the table. These screens can also be readily removed while the plant is in operation by inserting a spacer board in the side where the change is to be made, diverting the water and material to the other screen while the change is being made. Extra screens with any size of opening from 1/8-in. to 1/2-in. are stored in a rack conveniently located above the end of the spread table. The greater part of the table is covered with Cincinnati Rubber Co. rubber chute lining.

The material passing over the two stationary screens is loaded directly into cars and sold as road gravel. The material passing through the screens goes through a flume to a series of three Wood No. 6460 Auto-Vortex classifiers. Each classifier is connected to the next one in the series by a flume long enough to allow a smooth flow of water and material at the feed to the next classifier. The three sizes of sand produced are discharged to stock-piles from which they are loaded for shipment by crane. If desired, the coarse sand from the first classifier can be chuted directly into cars for shipment. These flumes and chutes are also lined with Cincinnati Rubber Co. rubber lining. The product of the first cone depends on the size of the stationary screen in use. The second cone produces concrete sand and the third plaster sand.

The overflow from the third cone is now thrown back into the river as wasted. Later a settling basin will be built to take this discharge. The 200-

Connection of dredge line to shore line which allows for variations in river levels.

The three sand classifiers alongside the flume.

mesh sand will be handled from the basin by crane.

A fourth cone is to be installed to supplement the first in recovering coarse sand. Concrete foundations are now in place for bins of 160-cu. yd. capacity which will be erected during the winter for the storage of gravel and coarse sand.

The entire plant is semi-portable and can be taken down and moved to a new location. The plant framework consists of steel poles. These have concrete footings which can be lifted out and reset at a new location. Three 750-watt General Electric floodlights illuminate the plant and dredge for night operation.

A Koehring gasoline crawler crane with a 1-cu. yd. Owen clam-shell bucket rehandles material to and from the stock-piles. The property of 12 acres owned by the company is served by two railroads, the Union Pacific and the Rock Island, with switching facilities to two other railroads in Topeka. Large storages of all grades of material are maintained along these tracks for re-loading. The Kansas Sand Co. has two other plants under construction in Topeka. The No. 2 plant is located on the Kansas River with A. T. & S. F. Railroad connections and the No. 3 plant, also on the Kansas River, is served by the Union Pacific Railroad. Both these plants have about the same amount of storage space as the present plant. Another small plant on the property is used for rescreening material for special work. A small drag-scraper feeds the material to an elevator and a 3-deck Niagara vibrating screen sizes the material and feeds it to bin storage of 400-cu. yd. capacity. Shipments are made from this plant by truck only.

Rack of screens above spread-table.

Factors Determining Lime in Clinkers

(*Continued from page 50*)

A consideration of these points seems to indicate that, if we wish to manufacture a high-early-strength cement, we must fulfil the following conditions besides those of perfect blending and burning which are obvious. The raw mix must be as fine as possible to increase the amount of lime which will combine. The mix must be controlled so that the lime is just below the amount of lime which would result in free lime. The silica/alumina ratio must be low in order to give the cement the rapid-hardening qualities.

To Develop Standard Specifications for Testing Sieves

The Standards Council of the American Standards Assn. has approved the initiation of a project to develop standard specifications for sieves for testing purposes (Z23). The American Society for Testing Materials and the U. S. Bureau of Standards have been appointed joint sponsors for the new project.

The organization of a sectional committee, which will include American technologists interested in sieves for testing purposes, is now under way. Specifications for sieves developed by the American Society for Testing Materials in coöperation with the U. S. Bureau of Standards, in 1926, will be used as a basis for the work of the committee.

THE low cost of water transportation is helping the cement industry to reduce shipping expense by sending bulk cement in barges to strategic locations for packing and distributing. One such example is the packhouse of Lone Star Cement Co. Virginia, located on the Potomac River at the nation's capital. It is described in an article which starts on page 37.

Added Recovery by Hydraulic Sizing of Fines in Land-Pebble Phosphate*

By R. G. O'MEARA

Asst. Metallurgist, United States Bureau of Mines, Southern Experiment Station, Tuscaloosa, Ala.

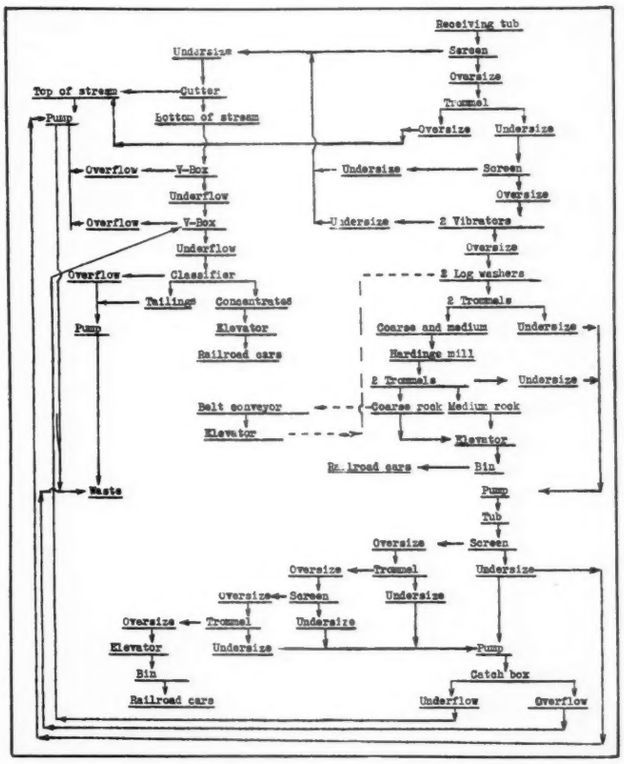
THE land-pebble district of Florida, which in 1928 supplied 96.7 per cent. of the phosphate production of that state and 82 per cent. of the domestic requirements of the United States, is centered in Polk and Hillsboro Counties about 30 mi. east of Tampa. The deposits are unconsolidated sediments occurring as beds of phosphate matrix overlain by a mantle of barren sands and clays. The matrix consists of a mixture of sand (quartz grains), clay, and phosphate rock in which the coarsest sand is much finer than the coarsest phosphate; that is, the sand is segregated in the fine material.

Before the introduction of classifiers the concentration consisted of log-washing, and screening at about 20-mesh, which was usually the finest size that could be taken to maintain commercial-grade, 66 per cent. B. P. L. (bone phosphate of lime) or more. When classifiers were introduced, some of the "fines" that had escaped at the head of the washery and some of the minus-20-mesh material isolated during the washing and formerly lost supplied the feed.

During October, 1927, the United States Bureau of Mines, in coöperation with the University of Alabama and the Missouri School of Mines and Metallurgy, began to investigate the amenability of phosphatic sands to gravity methods of concentration. The work was under the immediate supervision of B. W. Gandrud, acting supervising engineer of the Southern Experiment Station of the United States Bureau of Mines at Tuscaloosa, Ala., and Will H. Coghill, supervising engineer of the ore-dressing section of the United States Bureau of Mines.

More comprehensive testing followed and in the early part of 1930 some of the companies coöperated with the bureau and the above-mentioned institutions in conducting a series of tests on hydraulic classification and tabling. The results[1] indicated that marketable concentrates could be obtained with a recovery of 25 to 45 per cent. of the phosphate formerly lost.

As a result two companies have introduced hydraulic classification to treat the current "tailings," and one of them has substituted classifiers for the 20-mesh screens which had been unsatisfactory. Because the phosphate grains and quartz grains have nearly the same specific gravity, the use of concentrating tables by the customary methods is not applicable.



Flow-sheet of No. 1 washery.

The washeries included in the following report are designated as Nos. 1, 2, and 3.

* Reprinted from U. S. Bureau of Mines Report of Investigations 3 139.

[1] Lawrence (H. M.) and O'Meara (G). Gravity Concentration on Certain Florida Phosphatic Sands. Rept. of Investigations 3,018, July, 1930.

Table I.—SIZING ANALYSIS AND GRADE OF SPIGOT PRODUCTS FROM WASHERY No. 1

Size	Weight (*per cent.*)							
	Feed	Spigot 1	Spigot 2	Spigot 3	Spigot 4	Spigot 5	Spigot 6	Overflow
Plus- 14-mesh	6.1	42.7	22.1	3.5				
20-mesh	12.4	42.3	41.5	17.2	4.4			
28-mesh	14.2	13.1	29.4	33.6	9.4			
35-mesh	21.0	1.9	7.0	33.4	29.6	6.1		
48-mesh	25.6			12.3	40.5	38.7	8.4	
65-mesh	12.6				16.1	40.3	41.2	
100-mesh	5.3					12.5	37.0	
Minus-100-mesh	2.8					2.4	13.4	
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
Assay, per cent. B. P. L.	41.54	69.72	64.55	49.85	33.90	29.68	30.18	30.61
Assay, per cent. insoluble	45.50	11.14	18.35	35.23	53.69	61.49	60.30	56.84

Table II.—SIZING ANALYSIS AND GRADE OF PRODUCTS FROM A TYPICAL FEED TO WASHERY No. 2

Size	Weight (*per cent.*)							
	Feed	Spigot 1	Spigot 2	Spigot 3	Spigot 4	Spigot 5	Spigot 6	Overflow
Plus- 10-mesh	0.4	2.9	1.4	0.4				
14-mesh	3.7	27.6	23.7	9.7	3.5	1.5	0.7	
20-mesh	9.9	48.1	52.9	47.5	26.2	10.3	5.7	
28-mesh	8.9	19.1	21.0	37.8	53.3	44.1	10.4	
35-mesh	8.7	2.3	1.0	4.6	17.0	40.7	55.2	7.9
48-mesh	9.2					3.4	26.9	26.2
65-mesh	8.4						1.1	24.6
100-mesh	12.3							19.8
Minus-100-mesh	38.5							21.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Assay, per cent. B. P. L.		69.31	69.31	65.26	58.31	48.49	36.62	14.75
Assay, per cent. insoluble		10.60	10.89	15.25	24.04	36.83	51.48	79.46

The average feed in Washery No. 1 is 200 tons per hr. in a pulp of 15 per cent. solids. The recovery of washed rock is about 45 tons per hr., and the remainder, 155 tons per hr., passes to overflow tanks from which 35 to 40 tons per hr. is drawn through spigots to the classifier. The classifier circuit and many other details are shown in Fig. 1.

A 6-spigot hydraulic classifier of the constriction-plate type is used. It is 13 ft. long and increases in width from 16 in. at the feed end to 32 in. at the "tailings" end. The height of the dividers between the cells is 36 in. and the overflow weir, side and end, is 54 in. The openings in the constriction plate are ¼ in. in diameter and are placed on the corners of 2-in. squares. The spigots are 1¼ in. in diameter and discharge intermittently by a mechanical device. The hydraulic water is 430 gal. per min.

Two products are obtained from the classifier: Concentrates and "tailings." Depending on the variation in tonnage and grade of feed, the concentrates are obtained from either the first two, three, or four spigots. The remaining spigots and the overflow make "tailings." Table I shows the sizing of the respective flows from the spigots.

Of the 35 to 40 tons per hr. fed to the classifier about 6 tons per hr. is recovered as a marketable product.

Washery No. 2 receives about the same amount of feed as Washery No. 1. Two classifiers are used; one of them treats the product that was formerly "tailings," and the other is interchangeable with screens; when the amount of clay is excessive, the feed to the screens is turned to the classifier. A record of the sizing and grade of products is given in Table II.

As has been stated, the second classifier is interchangeable with screens. Normally the washery feed contains a great amount of clay which at times increases to such an extent that screening is inadequate because the concentrates contain a large percentage of flaky clay. Though ordinarily the product is commercial, an excess of flaky clay makes the classifier more satisfactory than screens. By the use of the classifier a product can be made that is not only higher grade than the screen "oversize" but also higher in grade than the regular washery coarse rock.

The two classifiers treat about 60 tons, and when both are in operation they recover about 15 tons of concentrates per hr. Both are of the constriction-plate type.

The feed at Washery No. 3 is 200 tons of solids per hr. in a pulp of 14 per cent. density. The recovery of washed rock is 50 tons per hr. and the remainder is treated in desliming devices from which the heavier and coarser portion is drawn to the classifier.

In this plant two hydraulic classifiers of the constriction-plate type have been substituted for fine screens. The cells are 10 in. square. The height of the dividers between the cells is 12 in. and the overflow weir is reduced to 3 in. above the top of the dividers. The diameter of the spigots ranges from 9/16 in. to 7/16 in. The discharge is continuous, the tonnage depending on the size of the spigots. The hydraulic water is 275 gal. per min.

Table III is a record of the performance of these classifiers. They recover about 8 tons of concentrates per hr. The grade of concentrates is governed by the number of spigots taken, and this in turn, is governed by the market demands.

Table IV is representative of the operation of the five classifiers in the three washeries. As near as can be determined they recover 29 tons of concentrates per hr. However, some of this was recovered

Table III.—SIZING ANALYSIS, WEIGHT AND GRADE OF SPIGOT PRODUCTS FROM WASHERY No. 3

Size	Weight (*per cent.*)											
	Feed	Spigot 1	Spigot 2	Spigot 3	Spigot 4	Spigot 5	Spigot 6	Spigot 7	Spigot 8	Spigot 9	Spigot 10	Overflow
Plus- 8-mesh	0.7	9.6	1.7	0.5								
10-mesh	1.8	12.0	6.3	3.3	1.7							
14-mesh	14.4	42.7	34.3	30.5	16.0	1.1						
20-mesh	22.0	29.5	43.3	50.5	59.3	20.7	3.3	0.3				
28-mesh	16.3	5.6	12.7	14.1	22.5	63.4	48.1	11.5	3.6	0.8		
35-mesh	15.6	.6	1.7	1.1	.5	14.8	43.1	71.4	58.7	13.6	0.9	
48-mesh	16.0						5.5	16.8	36.6	74.9	36.9	
65-mesh	11.3								1.1	10.7	58.6	
Minus-65-mesh	1.9										3.6	
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Assay, per cent. B. P. L.		67.81	66.51	66.16	64.08	48.05	32.98	21.05	16.12	11.58	8.65	
Assay, per cent. insoluble		6.74	9.63	10.23	12.84	33.89	53.69	55.71	76.35	82.65	87.91	
Weight (*per cent.*)	100.0	11.8	12.3	10.8	11.3	11.3	10.8	8.2	7.2	8.2	7.1	1.0

Table IV.—AVERAGE RESULTS OF THE FIVE CLASSIFIERS IN THE THREE WASHERIES

Size	Weight (*per cent.*)								
	Washery No. 1			Washery No. 2			Washery No. 3		
	Feed	Concentrates	Tailings	Feed	Concentrates	Tailings	Feed	Concentrates	Tailings
Plus- 8-mesh							1.9	2.8	
10-mesh	0.5	1.3					2.4	5.1	
14-mesh	4.7	11.6		3.0	11.8		14.8	31.6	0.9
20-mesh	9.8	26.3		6.5	26.5	2.4	21.0	43.4	5.6
29-mesh	11.1	27.9	4.4	9.7	32.5	4.7	15.3	14.8	15.6
35-mesh	13.7	26.2	9.7	14.0	23.0	12.5	14.4	2.3	25.7
48-mesh	15.2	6.7	31.2	21.3	6.2	26.6	17.4		33.6
65-mesh	15.0		31.3	45.5		53.8	11.3		16.8
100-mesh	13.8		17.4				1.5		1.8
Minus-100-mesh	16.2		6.0						
Totals	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Weight (*per cent.*)	100.0	17.0	83.0	100.0	17.2	82.8	100.0	42.7	57.3
Assay, per cent. B. P. L.	29.57	63.38	22.65	38.55	60.18	34.06	40.43	65.00	21.98
Assay, per cent. insoluble	62.06	22.07	70.25	49.55	22.59	55.07	44.72	11.50	69.06
Distribution of B. P. L.	100.0	36.4	63.6	100.0	26.8	73.2	100.0	68.6	31.4
Distribution of insoluble	100.0	6.0	94.0	100.0	7.9	92.1	100.0	11.0	89.0

before the flow-sheets were remodeled to accommodate the classifiers. The added recovery due to the classifiers is about 14 tons per hr. The added cost is so small that the operation is regarded as successful.

Though the operation in these plants is regarded as successful, the additional recovery is limited to the coarsest phosphate formerly wasted. The hindered settling ratio of sand and phosphate is so small that it is of little value. The losses in the "fines" are still high and the use of classification should be regarded as transitory, awaiting the perfection of a more applicable process.

Essentially, the washery practice of the land-pebble phosphate district of Florida consists of log-washing and screening on about 20 mesh. The "oversize" is the concentrates and the "undersize" is the "tailings." The phosphate losses have been due to the use of screens too coarse to recover the fine phosphate.

As early as 1927 hydraulic classification was considered as a means of retreating the "tailings." In 1930 two companies coöperated with the United States Bureau of Mines, the University of Alabama, Tuscaloosa, Ala., and the Missouri School of Mines and Metallurgy, Rolla, Mo., in conducting tests on classification and tabling of phosphatic sands. The results showed that table concentration could not be recommended, but that the sizing obtained by a hydraulic classifier would make possible a recovery of the coarsest part of the phosphate formerly sent to waste.

Following this work, one of the companies adopted hydraulic classification and obtained a recovery of 25 to 45 per cent. of the material fed to the classifier. During a 3-month operation the classifier added 15 per cent. to the production.

Another washery was equipped in a similar manner. The washery feed contained an unusually large amount of clay, and screening was unsatisfactory because of the residual flakes of clay in the washed product. After substitution of a classifier for some of the screens, higher-grade concentrates were obtained through the rejection of much of this flaky clay.

Now five classifiers are installed in three washeries, and hydraulic classification has increased the yearly production about 81,000 tons.

Unsoundness of Certain Rock Types Described by Engineer

The destructive effect of artificial and natural weathering conditions upon certain kinds of rocks, particularly shales, shaly limestones, iron oxides, iron-stones, cherts, and a miscellaneous class of soft, earthy rocks is described in a paper, *The Unsoundness of Certain Types of Rocks*, by Mark Morris, research engineer, Iowa State Highway Commission, in the Proceedings of the Iowa Academy of Science, 1931. Considerable space is allotted to a description of the effects upon concrete of the behavior of these rocks while decomposing or disintegrating as a result of exposure to natural weathering conditions, either at or near the surface.

The unsound rocks are classified according to origin as sedimentary or igneous rocks. The greater number found in Iowa, either in the original of the glacial deposit, are of sedimentary origin. Disintegrating granite particles in gravel deposits are the only unsound rocks of igneous origin.

From their behavior in soundness tests and in concrete structures, the unsound rocks may be classified into two groups. In one group may be listed these rocks which seem to fail without appreciable volume change, and in the other may be listed those which have a considerable volume change during the disruptive action which accompanies their disintegration and in some cases their decomposition.

Each member of the first group of unsound rocks is ordinarily found to be structurally weak. In this group are the soft iron oxides, the softer shales, clay balls, and the miscellaneous soft, earthy rocks.

The members of the second group are for the most part hard and structurally rather strong rocks. Their failure seems to be accompanied by relatively large volumetric changes which exert considerable force. Failures of this type of rock, therefore, affect a much greater volume of concrete than is occupied by the rock itself. In this group are the harder shales, the harder iron-impregnated shales, shaly limestones, and cherts.

In closing, the paper directs attention to needed research and outlines briefly contemplated research soon to be undertaken by the Iowa Highway Commission for the determination of volumetric coëfficients of various aggregates and unsound rocks.

The Relation of Labor Turnover to the Cement-Mill Accident Curve*

By W. L. WHITE, Jr.
Asst. General Manager, Medusa Portland Cement Co.

THE experience of the Medusa Portland Cement Co., has been that a very definite relationship exists between safety and labor turnover and resulting plant efficiency. The word safety is used in its psychological rather than its mechanical or educational sense.

There are four groups of people who must coöperate in order to insure good safety practice: (1) Company executives and officials, (2) plant managers and superintendents, (3) members of the plant safety committee, (4) individual employees.

Unless there is 100-per cent. coöperation among these four groups, good safety records will not be attained. I do not mean that the labor turnover will be reduced to nothing even if a perfect safety record be attained, but the improvement will be marked by contrast.

In 1928 attention was called by the Portland Cement Assn. to the fact that one of our plants had an extremely poor accident record. It was one of the lowest of the low twenty-five reporting to the association and had a high loss in hours through lost-time accidents and fatalities.

About 250 men are employed there and, because the accident record of this plant was far below that of other plants of the company, the officials were naturally very much concerned about it. Thinking that if the competitive spirit could be aroused conditions would improve, they constantly emphasized the poor showing that the plant was making when compared with other mills. This did little or no good. The safety committee continued to function in a more or less desultory manner, as it had for years, and very little honest-to-goodness safety work was being accomplished. During this period, as will be seen from the figures given later, the plant had a very high percentage of labor turnover.

In 1929 it was decided to try entirely new tactics. A safety director who had under his jurisdiction all the plants of the company was employed. His was a personal contact, man to man, and the positive, encouraging attitude was taken rather than the negative, discouraging attitude. New life and "pep" were put into the safety committee and it was told to forget past failures and to look ahead to what could be accomplished. Employees were urged to offer suggestions for additional mechanical safeguards and these suggestions were carried out wherever possible. An extensive educational program, through bulletins and posters, was carried on and, in short, every effort was made to give them a new outlook on the situation.

In August, 1929, this plant made a complete right-about-face. The safety movement gained ground rapidly and the next year, 1930, the plant was awarded a safety trophy.

*Read at the 1931 National Safety Congress.

The labor turnover percentages for the Medusa organization for the years 1929 and 1930 are:

Plant	1930	1929
Bay Bridge	1.45	1.31
Dixon	37.0	103.0
Toledo	20.3	45.0
York Gray	——	4.5
Wampum	12.9	12.0
Manitowoc	2.67	——
Newaygo	——	——
York White	7.8	12.1

While the labor turnover at Dixon was reduced but 8 per cent. in 1929, it was reduced 66 per cent. in 1930, and this is attributed entirely to the effect of safety, inasmuch as there was no change in the plant management.

It is a poor rule that does not work both ways and that applies to labor turnover and safety. A case can be cited where the labor turnover was extremely high and the safety movement carried on in a rather haphazard manner. A change in plant management was made and efforts were immediately directed to reorganization of personnel. This took a long time, but it was finally accomplished, and it was found that the increase in labor efficiency brought about a decrease in labor turnover, a corresponding increase in plant efficiency, and consequent reduction in cost.

Where there was anything but a smooth-running organization, prior to the change in plant management, after this change was effected and a suitable force of employees built up, the organization was as smooth-running as a clock and the lost-time accidents and accident-severity rating were reduced to the minimum. It is only reasonable to expect that accidents will occur with greater frequency where the worker's knowledge of the machinery and its operation is limited.

Then there is the "old" plant which might be termed a dangerous place in which to work. Two instances of this sort come to mind: one plant built in 1892, the other in 1901, both removed from industrial centers that might affect the labor turnover over a long period of time. Plant management has not been changed frequently and a stabilized force has been built up, the son often taking the place of the father. Labor turnover has been consistently low with correspondingly low accident frequency.

Results in safety work can not be secured in a short time, and the worse the record of the plant is, the longer it is going to take to clear it up. Missionary work, perseverance, patience, education are all part of the program, and there are many discouragements, but the results to be secured more than repay all the effort put into the work.

MEN OF THE INDUSTRY

The portrait printed on this page in each number of PIT AND QUARRY is selected without significance as to current events or the position of the individual in the industry.

C. M. HARDY
President
Hougland & Hardy, Inc.
Evansville, Ind.

Coming Events

Dec. 10, 1931. St. Louis, Mo. Monthly meeting, St. Louis Quarrymen's Assn., Forest Park Hotel. E. J. McMahon, exec. sec., 4063 Forest Park Blvd., St. Louis, Mo.

Jan. 9-15, 1932. Detroit, Mich. Annual Convention and show, American Road Builders' Assn. Chas. M. Upham, engineer-director, National Press Bldg., Washington, D. C.

Jan. 19-22, 1932. Pittsburgh, Pa. Annual Convention, National Crushed Stone Assn., Wm. Penn Hotel. J. R. Boyd, secretary, Merchandise Bldg., Washington, D. C.

Jan. 25-26, 1932. Pittsburgh, Pa. Annual convention, National Ready-Mixed Concrete Assn., Wm. Penn Hotel. V. P. Ahearn, executive secretary, Munsey Bldg., Washington, D. C.

Jan. 27-29, 1932. Pittsburgh, Pa. Annual convention, National Sand & Gravel Assn., Wm. Penn Hotel. V. P. Ahearn, executive secretary, Munsey Bldg., Washington, D. C.

Feb. 3-4, 1932. Washington, D. C. Annual meeting, Sand-Lime Brick Assn. Ellen Knight, sec., 321 N. Hamilton St., Saginaw, Mich.

Feb. 23-26, 1932, Wichita, Kan. Seventh Annual Southwest Road Show and School.

Feb. 23-26, 1932. Washington, D. C. Annual convention, American Concrete Institute, Wardman Park Hotel. Harvey Whipple, sec., 2970 West Grand Blvd., Detroit, Mich.

Pumping from the Old Pit

Excerpts from the old files of PIT AND QUARRY *reveal many interesting sidelights on the activities of the pits, quarries and plants of former days. These are printed in this column each issue.*

Fifteen Years Ago

FORMATION of the Barry Sand & Gravel Co. of Barry, Ill., was announced. The new firm was capitalized at $35,000 and plans were being formulated for the erection of a plant near that place. Incorporators were George Edward Hoffman, John C. Brendt, and Joseph Webb.

* * *

An article by H. D. Pratt, an engineer of the Link-Belt Co., described the new sand-and-gravel plant of the Penn Sand & Gravel Co. at Tullytown, Pa. Material from the pit was carried to the plant by dump cars which discharged to a pair of skips operating on a sharp incline. The material discharged by the skips at the top of the plant was sized and washed by conical screens.

* * *

Ten Years Ago

CONSTRUCTION was in progress on the new cement plant of the Western States Portland Cement Co. at Davenport, Ia. The work was being done under the direction of A. D. Stancliff. Equipment included five 220-ft. kilns each with a daily capacity of 1,000 bbl., giving the plant an output of 5,000 bbl. per day.

* * *

Four cities—Chicago, Cincinnati, New Orleans and St. Louis—were being considered as the meeting place for the 1922 convention of the National Assn. of Sand & Gravel Producers. The date for the annual gathering had been tentatively set for January 24 to 26. The National Crushed Stone Assn. had chosen Chicago for its convention.

* * *

A. E. Dickinson, J. E. Rowe and W. R. Martin announced the organization of the Imperial Stone Co. at Bedford, Ind. Incorporated under the laws of Indiana, the concern was authorized to issue $150,000 worth of capital stock.

* * *

Sand-and-gravel dealers in Dallas and other Texas cities were operating at full capacity, the report from the PIT AND QUARRY correspondent in that area declaring that the producers had "all the business they could handle." Gravel was being delivered on the job at prices ranging from $2.00 to $3.50 per cu. yd.

* * *

The Pittsfield Lime & Stone Co. of Pittsfield, Mass., was completing plans for improvements at its lime plants located in the Richmond-Summit district. Four new kilns were among the contemplated additions.

* * *

Five Years Ago

AMONG the new incorporations announced in December, 1926, were the following: Southern Limestone Co., Harriman, Tenn., J. N. Baker and W. C. Anderson, $60,000; American Portland Cement Co., Camden, N. J., F. R. Hansell, A. Celow, and John A. MacPeak; Klinker Sand & Gravel Co., Seattle, Wash., J. C. Klinker, Phillip Neary, and Edwin Neary, $25,000; Wolf Creek Sand & Gravel Co., St. Louis, Mo., E. O. Beyers, W. Grayson, Jr., and J. E. Shwarz.

Business for 1927 appeared quite promising, according to a symposium of opinions published in a composite article entitled "What's Ahead for 1927?" Among those predicting improved conditions during the ensuing year were B. F. Affleck, Universal Portland Cement Co., F. A. Wilder, Southern Gypsum Co., H. Struckmann, International Cement Corp., E. J. Krause, Columbia Quarry Co., Otho M. Graves, General Crushed Stone Co., and F. W. Renwick, Chicago Gravel Co.

New Corporations

RHODES-SHEA, INC., Leominster, Mass. 1,000 sh. n.p.v. Samuel M. Salny, Philip Salny and Ruth Williams, all of Fitchburg, Mass. To operate quarries.

WILLIAM J. BREEN GRAVEL CO., Grand Rapids, Mich. Incorporated with a capital of $150,000.

BINGHAMTON CRUSHED STONE & GRAVEL CORP., Binghamton, N. Y. To succeed Frank J. Boland, Inc.

DIAMOND LAKE SAND & GRAVEL CO., INC., 72nd St. & Washburn Ave., Minneapolis, Minn. Granted a charter with a capital stock of $50,000. E. Strom, Floyd Strom and Carl Carlson.

ABSECON SAND CO., Atlantic City, N. J. $125,000. Morrice Bloom. To produce sand, bricks, etc.

MIAMI ASPHALT PRODUCTS CO., Miami, Fla. C. F. Goodman, 1785 S. W. 13th St., and others.

K-W CRUSHED STONE CO., Germantown, Wis. 100 sh. at $100. H. Walterlin, A. Walterlin and A. Kannenberg. To produce crushed stone and construct highways.

Manufacturer Seeks New Material-Handling Ideas

Realizing that progress is constantly being made by adapting old ideas to new uses or by the application of new ideas to old problems, the Clark Tructractor Co. of Battle Creek, Mich., is seeking new devices, preferably in the material-handling line, for development and manufacture. The company, which now makes gasoline-propelled vehicles for industrial haulage, suggests that the foregoing points be kept in mind by prospective designers:

1. The machine should have a large field of usefulness, requiring reasonable quantity production.
2. It should be suitable for manufacture in a plant with complete modern equipment, including a steel foundry.
3. Labor-saving qualities should justify the purchase price.
4. Simplicity of design and operation are desirable factors.

Personal Mention

B. F. Morris, general manager of the Pioneer Sand & Gravel Co. of Seattle, Wash., has been elected vice-president of the Building Material Dealers' Assn. of Seattle.

Lewis Francis has opened a limestone crushing plant at Littleton, Ia., on properties which he owns. At present he is crushing around 35 tons a day.

Ralph E. Simpson, chief clerk in the state highway department of Indiana, has been named assistant director. Mr. Simpson joined the engineering staff of the department in 1919 and became chief clerk in 1929.

Perry D. Helser has resigned his position as vice-president of the Eljer Co., Ford City, Pa., to become executive vice-president and general manager of the General Ceramics Co., New York City.

J. D. Collins, of Atlanta, Ga., recently appointed southern representative by the Shunk Manufacturing Co., Bay City Shovels and the Pioneers Gravel Machinery Mfg. Co. writes: "You have made quite a natural error in announcing my address as Peachtree St. instead of 28 Peachtree Way. Atlanta is afflicted with too much Peachtree —I believe we have nineteen! Peachtree St. is in the center of Atlanta while Peachtree Way is six miles out."

J. D. Collins.

A. W. King, manager of the service department of the Cowham Engineering Co., Chicago, cement-mill operators and engineers, has severed his connection with the company following the receivership of the Consolidated Cement Corp., the largest of the concerns operated by the Cowham organization. Prior to his connection with the Cowham company he was connected with the Portland Cement Assn. Previous to that, Mr. King was in charge of the Materials Testing Laboratory of the Bureau of Science, Manila, Philippine Islands, for 10 years, during which period he was appointed professor of civil engineering in the College of Engineering, University of the Philippines. Later he was connected with the Kalman Floor Co. as sales engineer, and for two years was engaged in technical, research and promotion work for the Atlas Lumnite Cement Co.

Roland D. Doane, for several years advertising and sales promotion manager of the Lehigh Portland Cement Co., has joined Taylor, Rogers & Bliss, Inc., as director of its dealer-service division. The company is devoted exclusively to market analysis and sales development in the building industry. The new dealer-service division is established to work closely with building-material dealers throughout the country, assisting them with sales plans for products, particularly specialties, which may be sold profitably to local buyers.

A. W. Catlin was recently appointed Chicago district manager for the Dixie Machinery Mfg. Co. of St. Louis, and special representative for the Manitowoc Shipbuilding Corp. and the Manitowoc Engineering Works, with offices in the Builders Bldg., 228 N. LaSalle St., Chicago, Ill.

Mr. Catlin is a well-known mining engineer and was for 25 years closely identified with the Portland-cement industry and allied fields in the United States and Europe.

T. R. Lawson, professor of the department of civil engineering, Rensselaer Polytechnic Institute, has been elected vice-president of the American Society for Testing Materials to fill the vacancy caused by the death of S. T. Wagner, late consulting engineer of the Reading Co. Prof. Lawson was graduated from Rensselaer in 1898 with the degree of civil engineer and his connection with the Institute has dated from that time.

J. M. McKibbin, Jr., has been appointed sales promotion and advertising manager of the newly organized industrial department of the Westinghouse Electric & Manufacturing Co. He has been associated with Westinghouse since 1920. His first position was in the sales promotion department of the Pittsburgh office. In 1922 he was made advertising manager in Cleveland, and was transferred to Detroit in 1925. He later became advertising manager of the central district of Ohio, Pennsylvania and West Virginia.

J. M. McKibben, Jr.

Willis A. Slater.

Obituary

James E. Kuehl, 74, Bettendorf, Ia., died of heart failure, November 1. He was a pioneer resident of that city and was for many years associated with his father in the lime and stone business, later being manager of the LeClaire Stone Co.

Lewis Taylor Robinson, 63, engineer in charge of the general engineering laboratory of the General Electric Co., died suddenly from a heart attack at his home in Schenectady, November 3. Dr. Robinson was a veteran electrical technician, and for 12 years the head of one of the principal laboratories of General Electric. During recent years his activities in engineering and scientific bodies had been varied and constant, and the number of technical committees on which he had served in the past and of which he was a member at the time of his death was extremely large. His birthplace was Springfield, Mass.

J. Foster Cook, salesmanager for the Cumberland Portland Cement Co. was found dead recently in his office at Nashville, Tenn. A bullet wound between the eyes and other evidence pointed to suicide. He had been with the company since April, 1930, as sales-manager. He was buried at Springfield, Tenn.

Willis A. Slater, research professor of engineering materials and director of the Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa., died recently. In the field of investigations relating to concrete he occupied a high place. His indefatigable labors during the past 25 years and his many papers and reports have contributed largely to our growing knowledge of concrete and form part of the basis of present practice in construction and design. He was born in 1878 in Polo, Ill., and was educated at the University of Illinois. After two years in municipal engineering work he returned to the University of Illinois and joined the group of research workers who, under the leadership of Prof. Talbot, were then well on their way with those contributions to engineering science which have helped to make famous the engineering experiment station at Urbana. He remained with this group until 1917. When the war came, in 1917, Mr. Slater joined the Bureau of Standards and was placed in charge of the structural laboratory investigations in reinforced concrete for the concrete ship section of the Emergency Fleet Corp. In 1928 he came to Lehigh University as director of the Fritz Engineering Laboratory.

Latest Portland-Cement Statistics

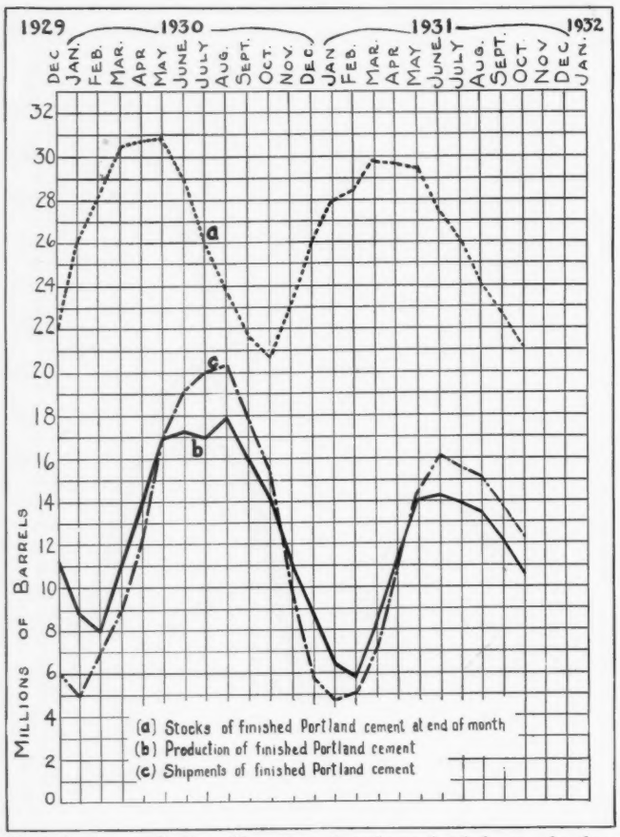

1929
1930
1931
1932
DEC JAN. FEB. MAR. APR MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC JAN FEB. MAR. APR MAY JUNE JULY AUG. SEPT. OCT NOV DEC. JAN.
MILLIONS OF BARRELS
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
(a) Stocks of finished Portland cement at end of month
(b) Production of finished Portland cement
(c) Shipments of finished Portland cement

Chart showing production, shipments and stocks on hand, by months, from December, 1929, to October, 1931.

THE Portland-cement industry in October, 1931, produced 10,762,000 bbl., shipped 12,360,000 bbl. from the mills, and had in stock at the end of the month 21,138,000 bbl. Production of Portland cement in October, 1931, showed a decrease of 25.3 per cent. and shipments a decrease of 20.8 per cent. as compared with October, 1930. Portland-cement stocks at the mills were 2.1 per cent. higher than a year ago.

In the statement of relation of production to capacity the total output of finished cement is compared with the estimated capacity of 165 plants both at the close of October, 1931, and of October, 1930. The estimates include increased capacity due to extensions and improvements during the period.

EXPORTS OF HYDRAULIC CEMENT BY COUNTRIES IN SEPTEMBER 1931

Exported to—	Barrels	Value
Canada	2,457	$ 9 944
Central America	1,852	4,173
Cuba	895	1,927
Other West Indies and Bermuda	5,003	8,795
Mexico	3,294	11,228
South America	11,622	32,368
Other countries	2,420	12,964
	27,543	81,399

DISTRIBUTION OF CEMENT

Shipped to—	August		September	
	1930	1931	1930	1931
Alabama	106,464	88,251	68,936	60,846
Alaska	4,465	1,666	1,362	835
Arizona	51,855	37,842	39,785	33,835
Arkansas	165,886	82,714	150,714	49,943
California	868,795	521,774	836,501	523,744
Colorado	106,576	77,569	82,050	87,979
Connecticut	205,553	159,855	195,962	159,798
Delaware	47,898	30,933	26,704	43,222
District of Columbia	126,581	122,153	137,507	125,178
Florida	85,673	68,905	76,333	51,414
Georgia	186,694	191,428	163,464	164,838
Hawaii	19,301	20,407	16,778	18,544
Idaho	52,084	23,842	46,308	19,173
Illinois	1,604,378	1,063,517	1,704,696	975,734
Indiana	686,122	592,825	497,163	466,096
Iowa	1,077,919	563,562	781,608	305,343
Kansas	271,491	242,108	250,548	173,915
Kentucky	265,288	185,402	241,402	173,093
Louisiana	235,564	498,824	163,544	555,155
Maine	128,866	75,516	148,381	59,275
Maryland	314,239	161,645	285,312	206,115
Massachusetts	328,187	332,816	331,061	392,466
Michigan	1,269,546	787,425	1,018,648	620,928
Minnesota	602,931	668,690	374,833	432,521
Mississippi	96,483	67,290	51,680	33,326
Missouri	770,346	466,196	710,759	424,958
Montana	36,407	34,859	44,217	30,420
Nebraska	226,618	319,336	241,572	264,988
Nevada	14,645	9,907	16,111	12,735
New Hampshire	81,651	78,995	84,449	59,641
New Jersey	709,844	550,716	610,200	599,005
New Mexico	36,680	20,056	28,870	21,342
New York	2,596,407	2,548,291	2,515,171	2,316,622
North Carolina	116,028	77,320	102,658	61,534
North Dakota	31,984	22,552	38,358	19,533
Ohio	1,286,700	700,988	1,103,327	805,284
Oklahoma	360,766	311,923	348,023	140,858
Oregon	114,400	93,759	112,133	88,543
Pennsylvania	1,912,983	869,155	1,557,564	857,987
Porto Rico	4,500	4,035	10,250	4,037
Rhode Island	83,057	59,797	100,664	63,719
South Carolina	236,649	141,224	245,776	186,108
South Dakota	72,829	95,711	86,654	86,660
Tennessee	285,916	106,227	294,910	99,884
Texas	605,660	562,895	573,392	601,256
Utah	44,554	24,194	39,116	26,160
Vermont	104,324	56,224	66,810	49,250
Virginia	179,227	146,156	174,179	151,914
Washington	341,647	223,760	328,595	188,660
West Virginia	216,018	166,437	196,307	161,154
Wisconsin	842,250	712,588	700,327	474,841
Wyoming	20,642	15,674	20,224	12,405
Unspecified	20,373	61,143	4,888	104,386
	20,261,944	15,147,077	18,046,784	13,647,200
Foreign countries	37,056	24,923	36,216	23,800
Total shipped from cement plants	20,299,000	15,172,000	18,083,000	13,671,000

IMPORTS OF HYDRAULIC CEMENT BY COUNTRIES AND BY DISTRICTS, IN SEPTEMBER, 1931

Imported from—	District into which imported	Barrels	Value
Belgium	Massachusetts	20,591	$21,235
	Porto Rico	2,013	1,461
	Total	22,604	22,696
Canada	Maine and New Hampshire	23	76
Cuba	Porto Rico	1,011	1,550
Denmark	Porto Rico	8,169	7,249
French Indo-China	Los Angeles	1	5
Japan	Los Angeles	1,750	1,842
United Kingdom	New York	13	89
Yugoslavia	Los Angeles	4	13
	Grand total	33,575	33,520

RELATION OF PRODUCTION TO CAPACITY

	October		September	August	July
	1930 (*per cent.*)	1931 (*per cent.*)	1931 (*per cent.*)	1931 (*per cent.*)	1931 (*per cent.*)
The month	65.4	47.4	55.3	60.2	62.0
The 12 months ended	64.2	48.6	50.2	52.0	53.8

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT, BY MONTHS, IN 1930 AND 1931 (*thousands of barrels*)

Month	Production		Shipments		Stocks at End of Month	
	1930	1931	1930	1931	1930	1931
January	8,498	6,595	4,955	4,692	27,081	27,759
February	8,162	5,920	7,012	5,074	28,249	28,612
March	11,225	8,245	8,826	7,192	30,648	29,676
April	13,521	11,245	13,340	11,184	30,867	29,715
May	17,249	14,010	17,224	14,200	30,891	29,554
June	17,239	14,118	18,781	16,077	29,364	27,602
July	17,078	13,899	20,153	15,545	26,289	25,934
August	17,821	13,549	20,299	15,172	23,824	24,313
September	16,124	12,092	18,083	13,671	21,889	22,736
October	14,410	10,762	15,599	12,360	20,697	21,138
November	11,098	.....	8,784	.....	23,056	.....
December	8,480	.....	5,688	.....	25,838	.....
Totals	160,905	.....	158,744	.....	.....	.....

PRODUCTION AND STOCKS OF CLINKER, BY DISTRICTS, in OCTOBER 1930 and 1931 (*thousands of barrels*)

District	Production		Stocks at End of Month	
	1930	1931	1930	1931
Eastern Pa., N. J., and Md	2,470	2,089	1,025	688
New York and Maine	1,183	992	430	209
Ohio, Western Pa., and W. Va	1,525	741	648	714
Michigan	1,141	615	819	571
Wis., Ill., Ind., and Ky	1,706	1,140	649	339
Va., Tenn., Ala., Ga., Fla., and La	1,088	877	876	597
Eastern Mo., Ia., Minn., and S. Dak	1,590	924	500	508
W. Mo., Neb., Kan., Okla., and Ark	992	814	301	479
Texas	522	583	328	266
Colo., Mont., Utah, Wyo., and Idaho	160	59	329	126
California	1,091	686	1,025	1,236
Oreg. and Wash	427	305	336	365
Totals	13,895	9,825	7,266	6,098

PRODUCTION, SHIPMENTS, AND STOCKS OF FINISHED PORTLAND CEMENT, BY DISTRICTS, IN OCTOBER, 1930 AND 1931, AND STOCKS IN SEPTEMBER 1931 (*thousands of barrels*)

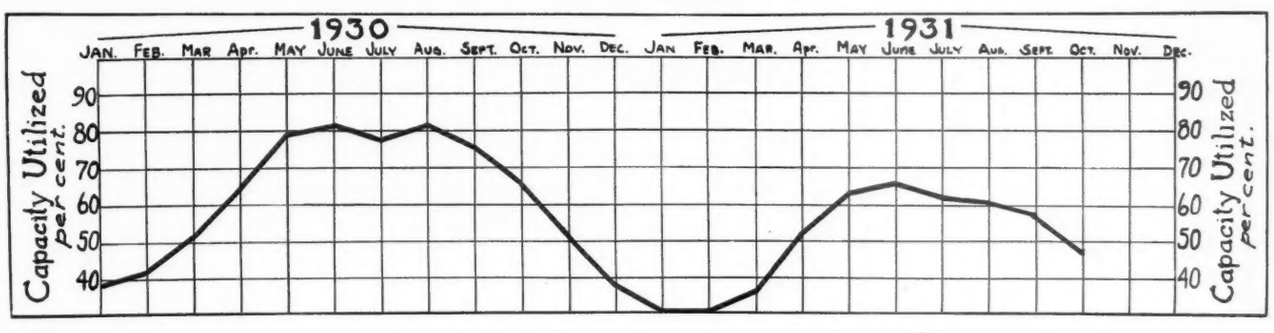
District	October						Stocks at End of September 1931
	Production		Shipments		Stocks at End of Month		
	1930	1931	1930	1931	1930	1931	
Eastern Pa., N. J., and Md	2,793	2,369	3,535	3,123	4,255	4,668	5,422
New York and Maine	1,220	1,110	1,201	1,231	1,088	1,159	1,281
Ohio, Western Pa., and W. Va	1,655	904	1,704	1,139	3,030	3,109	3,344
Michigan	1,130	602	1,093	616	2,317	1,893	1,908
Wis., Ill., Ind., and Ky	1,938	1,337	2,115	1,662	2,546	2,324	2,648
Va., Tenn., Ala., Ga., Fla., and La	1,132	1,009	1,248	1,050	1,697	1,684	1,725
Eastern Mo., Ia., Minn., and S. Dak	1,591	975	1,618	995	1,542	2,341	2,361
W. Mo., Neb., Kan., Okla., and Ark	957	795	947	881	1,652	1,219	1,305
Texas	484	601	469	583	721	558	539
Colo., Mont., Utah, Wyo., and Idaho	134	117	227	185	414	474	541
California	953	698	1,006	662	963	1,085	1,050
Oreg. and Wash	423	245	436	233	472	624	612
Totals	14,410	10,762	15,599	12,360	20,697	21,138	22,736

EXPORTS AND IMPORTS OF HYDRAULIC CEMENT, BY MONTHS, IN 1930 AND 1931

Month	Exports				Imports			
	1930		1931		1930		1931	
	Barrels	Value	Barrels	Value	Barrels	Value	Barrels	Value
January	82,387	$293,135	41,199	$115,678	201,609	$207,461	97,057	$132,937
February	64,267	217,798	25.703	88,989	114,455	119,717	22,370	26,250
March	117,563	357,896	54,599	144,579	43,622	59,981	70,532	80,686
April	57,419	200,217	40,478	116,564	140,871	178,226	54,717	61,728
May	57,423	198,170	48,028	140,953	94,696	111,998	20,061	22,794
June	82,077	223,639	43,619	107,977	55,356	74,370	32,080	42,955
July	47,082	166,577	29.494	97,995	12,404	20,973	17,445	22,349
August	49,031	167,579	39 517	106,643	35,323	39,029	9,760	13,404
September	46,664	153,384	27,543	81 399	51,096	59,721	33,575	33,520
October	62,690	190,305	.....	.....	75,284	84,364	.....	.....
November	50,495	151,555	.....	.....	109,124	125,448	.....	.....
December	38,680	134,260	.....	.....	44,157	59,641	.....	.....
Totals	755,778	$2,454,515	.....	.....	977,997	$1,140,929	.....	.....

PRODUCTION AND STOCKS OF CLINKER BY MONTHS, IN 1930 AND 1931 (*thousands of barrels*)

Month	Production		Stocks End of Month		Month	Production		Stocks End of Month	
	1930	1931	1930	1931		1930	1931	1930	1931
January	10,504	8,129	9,646	10,384	July	15,069	12,246	11,684	10,209
February	10,008	7,473	11,572	11,946	August	15,244	11,664	9,275	8,468
March	13,045	9,586	13,503	13,318	September	14,577	10,414	7,783	6,918
April	15,025	11,540	15,164	13,854	October	13,895	9,825	7,266	6,098
May	16,607	13,159	14,668	13,087	November	11,639	.....	7,758	.....
June	15,895	12,679	13,452	11,837	December	9,484	.....	8,809	.....



Production capacity utilized by months, January, 1930, to October, 1931.

Recent Patents

AMERICAN

Blasting

Safety blasting device. Frank H. Armstrong, Chicago, Ill., assignor to Safety Mining Co., same place. No. 1,829,847.

Blasting cartridge. Raymond W. Dull, La Grange, Ill., assignor to Safety Mining Co., Chicago, Ill. No. 1,829,855.

Blasting cartridge. Frank H. Kneeland, Chicago, Ill., assignor to Safety Mining Co., same place. No. 1,829,866.

Cement and Concrete

Process of manufacturing colored Portland cement. Gustav Bergen, Felix Engelhardt, and Richard Sieckhan, Brunswick, Germany. No. 1,829,082.

Method of making porous cement. Ernest Walter, Newark, N. J. No. 1,829,381.

Crushing and Grinding

Hammer-mill. Theodore C. Alfred, Lancaster, O. No. 1,829,325.

Excavating

Grapple. Howard C. Barbour and Roy H. Zeilman, Lorain, O., assignors to Thew Shovel Co., same place. No. 1,828,919.

Dipper-trip. Frank A. Fuller and Carl M. Moore, Erie, Pa., assignors to Bucyrus-Erie Co., South Milwaukee, Wis. No. 1,828,965.

Excavator crane. Holger L. Mitchell and Rolf Ljungkull, Milwaukee, Wis., assignors to Harnischfeger Corp., same place. No. 1,829,569.

Replaceable thimble-point dipper-tooth. John O'F. Clark, University City, Mo., assignor to American Manganese Steel Co. No. 1,829,851.

Back-digging shovel. Mitchell L. Fykse, South Milwaukee, Wis., assignor to Bucyrus-Erie Co., same place. No. 1,829,987.

Dump means for power-operated shovels. Antonio Calabrese, Seattle, Wash. No. 1,830,224.

Lime

Hardening and waterproofing composition for lime and the like products. Douglas M. Harrison, East St. Louis, Ill., assignor to McKenzie Mortar Co., Pittsburgh, Pa. No. 1,829,746.

Transportation

Material-handling apparatus. Arthur Shelburne, Terre Haute, Ind., assignor to Sullivan Machinery Co., Claremont, N. H. No. 1,828,751.

Traction steering clutch and brake arrangement. Robert L. Brown, Milwaukee, Wis., assignor to Harnischfeger Corp., same place. No. 1,829,978.

FOREIGN

Blasting and Explosives

Processes for the manufacture of explosives containing calcium nitrate. Dynamit-Akt.-Ges. vorm. A. Nobel & Co., Hamburg. British 357,432.

Manufacture and production of explosives and blasting charges. Dynamit-Akt.-Ges. vorm. A. Nobel & Co. British 358,157.

Safety-device for blasting—charges employed in mining and similar work. W. Voortmann. British 358,369.

Cement and Concrete

Processes and plant for the manufacture of cement, and the product obtained thereby. M. T. J. Lepine (nee Roussel). British 358,096.

Retort for the distillation of coal, oil-shale or other solid carbonaceous material, and adapted for use in conjunction with a rotary cement kiln. E. S. Handasyde. British 358,110.

Process for production of insulating and light-weight concrete. Kasp. Winkler & Co. G. m. b. H., Durmersheim i. Baden. German 537,505.

Concrete manufacture. Kaspar Winkler, Zurich, Switzerland. Canadian 316,668.

Process and apparatus for manufacture of cement. Miag Muhlenbau und Industrie Akt.-Ges. French 708,290.

Cooling

Apparatus for cooling granular material, particularly cement clinker from rotary kilns. Fried. Krupp Grusonwerk Akt.-Ges., Magdeburg-Buckaw. German 537,171.

Crushing and Grinding

Pulverizing and like mills. E. W. Green and G. R. Unthank. British 357,542.

Pulverizers. Erie City Iron Works. British 357,669.

Pulverizing installation. Babcock & Wilcox, Ltd. (C. Peters). British 358,219.

Compound mill. Gebr. Pfeiffer Barbarossawerke Akt.-Ges., Kaiserlautern. German 537,056.

Drilling

Couplings for drill stems. W. S. Gattrell. British 357,271.

Driving device for impact tools. Dipl.-Ing. Hans Lembcke, and Dipl.-Ing. Paul Schmidt, Munich. German 537,685.

Rock drill. Gebr. Böhler & Co., Akt.-Ges., Berlin. German 537,687.

Dust-sucking apparatus. Otto Schreiber, Neunkerchen. German 537,688.

Cable-line device for drilling machines. The Loomis Machine Co., assignee of Jonah Reynard, Tiffin, Ohio. Canadian 316,937.

Excavating and Loading

Loading machines for use in mining operations. British Jeffrey-Diamond, Ltd., and H. N. Wood. British 357,709.

Stripping machine. Lübecker Maschinenbau-Gesellschaft, Lübeck. German 536,987.

Stacker. Fred D. Coppock, Greenville, Ohio. Canadian 316,856.

Power shovel. Thew Shovel Co., Lorain, assignee of Emery J. Wilson, Cleveland Heights, Ohio. Canadian 317.072 and 317,073.

Machine for the rapid exploitation of mines or quarries. A. Chopin. French 708,268.

Dredge for excavating, washing and screening gravel. J. Holemans. French 708,335.

Material-Handling

Aërial conveyors. J. W. White. C. O. Valberg and C. S. Lowe. British 357,094.

Cargo-unloading apparatus for vessels. A. E. White (Robins Conveying Belt Co.). British 357,346.

Belt or band conveyors. D. P. Gilbert. British 357,547.

Jigging conveyors. E. Ridgill. British 357,628.

Tip buckets or containers for transporting and discharging materials in bulk. R. H. Annison. British 357,707.

Means for placing pans on traveling conveyors. Baker Perkins, Ltd. British 357,897.

Link construction for conveyors. L. Llewellyn and C. L. Kenney. British 358,162.

Automatic weight totalizers as applied to conveyors. S. C. Brown. British 358,320.

Scraper for reclaiming from storage. Franz Kerner, Suhl i. Thür. German 536,985.

Loading cars by means of belt conveyors. Friedrich Oberhage, Rheinhausen A. Niederrhein. German 537,081.

Cableway for continuous operation. J. Pohlig Akt.-Ges., Köln-Zollstock. German 536,986.

Apparatus for tripping material off of continuously-operating conveyors. Hermann Müller, Dresden. German 538,002.

Conveyor chain for lump material. Vogtländische Maschinenfabrik (vorm. J. C. & H. Dietrich), Akt.-Ges., Plauen i. V. German 537,905.

Bin with side discharge. J. Pohlig Akt.-Ges., Köln-Zollstock. German 537,736.

Bin-unloading device. J. Pohlig Akt.-Ges., Köln-Zollstock. German 537,737.

Portable conveyor. Fred D. Cop-

(Continued on page 76)

PIT AND QUARRY *will furnish, at its actual cost, a copy of any patent cited here. A charge of ten cents per copy is made by the U. S. Patent Office, Washington, D. C., and readers may procure a copy directly by addressing the Commissioner of Patents, with payment for copies requested. Postage stamps are not accepted by the Patent Office. We will endeavor to obtain copies of foreign patents for our readers but we cannot give assurance in every case for the reason that copies of such patents are not printed for distribution as liberally as are the American copies, nor is there a fixed charge per copy.*

Traffic News and Comment

New Complaints Filed

Cement.—The Interstate Commerce Commission has suspended from November 9, 1931, until June 9, 1932, schedules in Supplement No. 31 to Johanson's I. C. C. No. 2,179. The suspended supplement proposes to revise the rates on cement in carloads, from Harrys and Eagle Ford, Tex., to various destinations in Arkansas and Louisiana, using the mileage from Dallas, Tex., proper, Harrys and Eagle Ford being located in the Dallas switching district. This would generally result in reductions. I. C. C. I. & S. Docket No. 3,649.

Recent I. C. C. Decisions

Raw Dolomite, Fluxing Stone, Agricultural Limestone and Gravel.—Carriers in C. F. A. territory filed schedules to become effective Feb. 15, 1931, which proposed to restrict the rates on dolomite, fluxing stone, agricultural limestone and gravel, in carloads, from Gibsonburg, Carey and Woodville, O., and Greencastle, Ind., to various destinations in central territory so as to limit their application to shipments in open top equipment. They proposed also, by concurrent filing of an additional tariff, to apply 60 per cent. of sixth class, when this traffic is loaded in box cars, to provide for instances where no rates exist for movement in that type of car. These schedules were suspended by the Interstate Commerce Commission and by the Ohio and Indiana Public Utilities Commissions.

Respondents attempted to show that the rate on shipments in box cars should be higher than that on shipments of the same commodity in open top equipment and gave as their reasons the difference in loading and the higher average cost of box cars.

The restrictions were not made applicable at all producing points, Piqua, O., a point of heavy production, and all producing points in Illinois being left out of this general advance.

In a previous case reported in 172 ICC 532, the Commission prescribed a basis of rates on raw dolomite in box cars from Gibsonburg to various destinations. To stations in Indiana the rates are approximately 49 per cent. of sixth class.

Summing up their conclusions the Commission said, "From the foregoing we are convinced that the piecemeal adjustment here attempted would result in a more confused condition of the limestone rates than now exists. Respondents express the hope that we will prescribe a reasonable basis of rates on limestone in box cars under which they can revise all the rates from all producing points and put them on the same level. This would be tantamount to a general revision of the limestone rates without notice to all producers and shippers of this commodity. Furthermore, respondents in this proceeding have not seriously attempted to show that the present basis of rates is lower than reasonable, but their evidence was directed mainly to showing that they should receive more for the transportation of limestone in box cars than in open top equipment for the reasons stated hereinbefore. We find that the suspended schedules have not been justified. I. C. C. I. & S. Docket No. 3,571.

Rate-Committee Dockets

New England Freight Assn.

Sand and Gravel.—To meet barge and truck competition carriers propose to reduce the rate on sand and gravel[1], from Scotia, N. Y., to Petersburgh, N. Y., from $1.20 to 95c. per net ton. Docket No. 23,795.

Trunk Line Assn.

Crushed Stone, Sand, Gravel and Slag.—Shippers propose the establishment of the following rates on crushed stone, sand, gravel and slag, as described in B. R. & P. Tariff I. C. C. 8,316, from Buffalo, N. Y. Rates are per net ton. Docket No. 27,970.

To	Rate
Lanes Mills, Pa.	$1.30
Sykesville, Pa.	1.40
Marion Center, Pa.	1.50
Homer City, Pa.	1.60
Anita, Pa.	1.50
Valier, Pa.	1.50

Ground Limestone.—Shippers propose a reduction in the rate on ground limestone, c.l. min. wt. 50,000 lb., from York, Pa., to NeMours, W. Va., from 43 cents to 21½ cents per 100 lb. Docket No. 27,938.

Shippers at Stover, Pa., are proposing the establishment of commodity rates on ground limestone c.l. min. wt. 50,000 lb., to various destinations in New Jersey and New York, same as concurrently in effect to the same destinations from Bellefonte, Pa. Docket No. 27,978.

Shippers at Natural Bridge, N. Y., propose the following rates on ground limestone, c.l. min. wt. 50,000 lb., to destinations taking the following bases in Agents Curlett's Tariff I. C. C. No. A-306. Docket No. 27,999.

	Rate
60 per cent.	$0.17½
67 per cent.	.19½
70 per cent.	.20½
71 per cent.	.20½
74 per cent.	24½
76 per cent.	.22
78 per cent.	.22½

Sand.—Carriers propose to establish a rate on sand[1] (blast, building, engine, glass, quartz, foundry, silex and silica), from Berkeley Springs, Great Cacapon and Hancock, W. Va., to Oshawa and Kingston, Ont., of 24½ c. per 100 lb. Docket No. 27,852, Sup. 1. They also propose the establishment of a rate of 24½ c. on the same commodity from the same points of origin to Peterboro, Ont., in Docket No. 27,853 Sup. 1.

Shippers of common sand from Kenvil and Hopatcong Jct., N. J., propose the establishment of a line of rates on those commodities[1], to C. R. R. of N. J. stations, Hometown, Sandy Run Jct., Tunnel, Nantichoke, Plains Jct., Taylor and Scranton, Pa., ranging from $1.20 to $1.40 a net ton. Docket No. 27,947.

The establishment of a rate on sand[1], from Pinewald and Quail Run, N. J., to Alexandria, Va., of $2.25 per net ton when loaded in open top cars, and $2.80 per net ton when loaded in box cars, is proposed by carriers. Docket No. 27,881, Sup. 1.

Carriers propose to establish a rate on industrial sand[1], and on ground flint, c.l. min. wt. 40,000 lb., to Lisbon, O., from Hancock, Great Capacon and Berkeley Springs, W. Va., of $2.40 and from Gore, Va., of $2.55 per net ton. Docket No. 27,703, Sup. 2.

Sand and Gravel.—It is proposed by shippers to establish a rate of 90 c. per ton on sand and gravel[1], from Kenvil, N. J., to Allentown, Pa., and 70 c. per ton from Springtown, N. J., to Bethlehem and Allentown, Pa. Docket No. 27,944.

To meet motor truck competition, shippers propose that the rate on common sand and gravel[1], from Machias, N. Y., to Varysburg, N. Y., be reduced from 83 c. to 75 c. a net ton. Docket No. 27,961.

To meet motor truck competition, shippers propose a reduction in the rate on common sand and gravel[1], from Clarence, N. Y., to Akron, N. Y., from 55 c. to 40 c. per net ton. Docket No. 27,994.

Shippers at Haven, N. Y., propose that the rate on common sand and gravel[1], to Cadosia, Tylers, Fish's Eddy, East Branch and Trout Brook, N. Y., be reduced from $1.00 to 91 c. a net ton. Docket No. 28,006.

Other Commodities.—To place receivers at East Canton, O., on a comparable basis with those located at Beloit and Salem, O., and other points in the same general territory, they propose the establishment of rates on boards (plaster), clay, feldspar, flint, gypsum (crushed or ground), plaster, stone (cornwall and whiting), carloads, from Baltimore, New York and Philadelphia, and points taking same rates, to East Canton, O., located in so-called 71 per cent. territory, on the basis of 1½ c. per 100 lb., over rates applicable to points taking rate basis 60G. Docket No. 28,019.

Central Freight Assn.

Agricultural Limestone.—Carriers propose to reduce the rate on agricultural limestone, c.l. min. wt. 50,000

lb., from West Columbus, O., to Buffalo, N. Y., from $2.52 to $2.27 a net ton. Docket No. 29,727.

Crushed stone.—Carriers propose to reduce the rate on crushed stone from Bloomville, O., to Bucyrus and Hines, O., from 60 c. to 50 c. a net ton. Docket No. 29,653, cancels Docket No. 29,649.

A reduction in the rate on crushed stone from Bellevue, O., to New Cumberland and Somerdale, O., from $1.20 to $1.15 a net ton is proposed by shippers. Docket No. 29,687.

A proposal to reduce the rates on crushed stone and related articles from Keeport, Ind., to Warsaw, Ind., and Milford Jct., Ind., from 90 to 80 cents and from 95 to 85 c. a net ton, respectively, has been made by carriers. Docket No. 29,717.

Shippers are asking that the rate on crushed stone and related articles from Whitehouse, O., to Mt. Pleasant, Mich., be reduced from $1.45 to $1.42 a net ton. Docket No. 29,716.

Dolomite.—A reduction in the rate on raw dolomite in box cars from Carey, O., to Clarion, Pa., from $4.50 to $2.25 a net ton, is proposed by shippers. Docket No. 29,700.

Lime.—Carriers propose to publish commodity rates on refuse lime (having no value for chemical or building purposes), in bulk, in open top cars, from Milltown, Ind., to destinations on the P. R. R. between New Albany, Ind., and Indianapolis, Ind., 80 per cent. of the mileage scale of lime rates prescribed in I. C. C. Docket No. 16,170, Sub. 1. Classification basis now applies. Docket No. 29,684.

Roasted Dolomite.—Shippers at Genoa and Martin, O., are asking for the establishment of a rate of $1.44 per net ton on burnt or roasted dolomite to Detroit, Mich. The present rate is $1.70. Docket No. 29,710.

Sand.—Shippers are proposing a reduction in the rate on molding sand in open top equipment, from McKees Rocks, Pa., to Braddock and Bessemer, Pa., from 80 c. to 60 c. a net ton. Docket No. 29,709.

Carriers propose to establish on burnt or refuse foundry sand, c.l. min. wt. 60,000 lb., from Buffalo and Black Rock, N. Y., to Toronto, Ont., a rate of $1.80 a net ton. The sixth-class rate now applies. Docket No. 29,705.

Sand and Gravel.—Shippers at Massillon, O., are asking for a reduction in the rate on sand and gravel, to Fredericksburg, O., from 70 c. to 65 c. a net ton. This rate to expire in six months from effective date. Docket No. 29,698.

Rates on common sand and gravel from Ashtabula and Ashtabula Harbor, O., to destinations on the N. Y. C. have been proposed by shippers. Representative proposed rates are: Conneaut, O., 60 c.; North Girard, Pa., and Wick, O., 70 c.; Erie, Pa., and Hartford, O., 80 c.; Sharon, Pa., 90 c. These proposed rates would result in reductions of from 10 c. to 20 c. per ton. Docket No. 29,720.

Western Trunk Lines Committee

Crushed Stone.—It is proposed to reduce the rate on crushed stone[1], from Luverne, Minn., to Sibley, Ia., from 5½ c. to 3½ c. per 100 lb. Docket No. 2,051-QQ.

Plaster and Plasterboard.—Shippers of plaster and plasterboard are proposing the establishment of rates on those commodities, c.l. min. wt. 40,000 lb., from points in Iowa, Kansas, S. Dakota and Wyoming, to points in W. T. L. Territory based on a mileage scale. The present rates are carried in W. T. L. Tariff, 29-series. A complete copy of the scale will be furnished on request. Representative mileages and rates carried in Docket No. 7,722, are:

Miles	Plaster	Plasterboard
25	10.5	13
100	14.5	17
300	19.5	22
500	22.5	25
750	26.5	29
900	28.5	31

Southern Freight Assn.

Artificial Bituminous Rock.—It is proposed to establish rates on artificial bituminous rock, and on bituminous composition or compound, from origins in the Birmingham district to all points in S. F. A. territory, including points in the Peninsula of Florida, on basis of the same scales on the rock now in effect on natural bituminous rock from origins in Kentucky such as Big Clifty and Bowling Green. On the bituminous composition or compound, which is also a manufactured product, and is used in connection with the artificial rock as a surfacing material, it is proposed to establish rates made 15 per cent. of current first-class rates. There are no specific commodity rates in effect at the present time. Docket No. 55,828.

Cement.—Carriers propose to eliminate the arbitrary carried by the G. S. W. & G. R. R. in connection with rates on cement from southern points to Georgia, Southwestern and Gulf R. R. stations, placing this carrier on standard line basis. Docket No. 55,822.

Sand.—Carriers propose to restrict the rates in Agent Glenn's Tariff No. 88-A, so as not to apply on molding sand, to cancel other commodity rates on molding sand between points in southern territory, and establish rates in lieu thereof based 120 per cent. of the common sand rates (Docket 17,517 rates). Rates from points north of the Ohio River to Southern points which have been published on basis of combination, using either the common sand or molding sand rates south of the Ohio River, are to be revised to reflect such new factors as may be adopted as result of revision south of the Ohio River. Docket No. 55,830.

Southwestern Freight Bureau

Lime.—A shipper at Osceola, Mo., is asking to be put on the same basis as shippers at Ash Grove, Springfield, Mo., and Ft. Scott, Kans., on shipments of lime to Atreco, Beaumont, Chaison, Port Arthur and South Beaumont, Tex., by publication of a rate of 29½ c. to these destinations. Docket No. 23,645.

Trans-Continental Freight Bureau

Plasterboard.—Shippers request that Items 4,491 and 7,500-A, of Tariff 1-J, and Item 1,210 of Tariff 4-G, be amended to permit privilege of stopping-in-transit to partly unload shipments of plasterboard at a charge of $6.30 per car per stop. Docket No. 13,013.

[1]The carload minimum weight will be 90 per cent. of the marked capacity of the car, except, when car is loaded to full cubical or visible capacity, actual weight will apply.

Recent Patents

(*Continued from page 74*)

pock, Greenville, Ohio. Canadian 316,855.

Conveyor belt. The Goodyear Tire & Rubber Co., assignee of Raymond S. Carter, Akron, Ohio. Canadian 317,024.

Mixing

Method and apparatus for charging concrete mixers. P. W. Yett. British 358,218.

Machines for mixing concrete and similar products. Firme Winget, Ltd. French 708,304.

Sacking

Process and apparatus for mechanical packing of weighed quantities of pulverous material into valve bags. K. Middelboe. British 358,171.

Screening and Separating

Apparatus for vibrating screens, shaking tables, and other apparatus. General Electric Co., Ltd., and J. W. Sherwen. British 357,214.

Removal of suspended matter from liquids. W. W. Triggs (Dorr Co.). British 357,967.

Means adapted for imparting vibratory motion to screens and the like. H. A. Edwards and R. Cort & Son, Ltd. British 358,119.

Unclassified

Method of leaching phosphate rock. Kunstdünger - Patent - Verwertungs-Akt.-Ges. British 357,580.

Pit-props and similar shoring devices. G. Lister. British 357,673.

Extensible pit-props. D. C. Poyner. British 357,679.

Production of a material for covering bituminous-road surfaces by impregnation of fragments or gravel with bituminous materials. O. Donig. British 357,699.

Pit-prop drawers and similar appliances. W. T. S. Jones and C. E. King. British 357,810.

Treatment of siliceous materials. P. Spence & Sons and A. Kirkham. British 357,993.

Manufacturers of artificial stone or concrete blocks and the like. F. T. Walker. British 358,047.

Process of feeding shaft kilns. Hollandsche Chemicalien Handel. French 708,244.

Uniform Sand Rates Vigorously Opposed

PRODUCERS FILE EXCEPTIONS

Sand-and-gravel producers from all parts of official classification territory have literally deluged the Interstate Commerce Commission with exceptions to the proposed report of Examiner Burton Fuller, which sought to recommend a uniform scale of freight rates on industrial sand between points in official-classification territory.

The report covered about thirty formal complaint cases which had been brought before the commission attacking sand or gravel rates within official territory. They were all consolidated in one report under the heading, "Industrial Sand Cases, 1930." Virtually every complainant and some of the defendants have filed exceptions to the report.

Any attempt to digest the arguments of all those who took exception to the report is obviously precluded here because of space limitations. One brief, filed by the Illinois Silica Sand Traffic Bureau, however, is worthy of discussion and is, to a degree, typical of many of the arguments presented by those opposing Examiner Fuller's recommendations.

The Illinois brief took the position that the report was unreasonable, contrary to law and to the weight of evidence. The issue was said to be an aggravated one and one of long standing. The Illinois association, the brief said, is "fully cognizant of the difficulties with which the examiner is beset in the preparation of a report in rate proceedings of this nature where the facts are many and controverted and there is more or less confusion as concerns the issues."

The association took exception to Examiner Fuller's report only with reluctance, the brief said, but it was forced into it upon reaching the conclusion that the examiner, in his effort to work out an extensive and what he may believe to be a uniform basis of rates, disregarded essential evidence and incorporated recommendations not supported by the record.

The Illinois bureau particularly protested against Mr. Fuller's recommendation that a different basis of rates should be applied on industrial sand from that on common building sand. This recommendation is a "very drastic departure from the practices of the past, the wisdom whereof is still to be weighed in the balance of time," according to the brief.

"Why complicate a dubious experiment further by adding refinement and super-refinement to an already complicated venture as concerns the 'industrial sand' feature of the controversy?" the brief asked.

The brief declared the record in the case "is barren of essential testimony and evidence of a probative value on which the examiner could suggest a segregation of ground or pulverized sand from other types of industrial sand; to classify ground or pulverized sand with amorphous silica, clay, flint or tripoli; and to determine class or column 16 rates as an appropriate rate level for future application to this traffic.

"If in its wisdom the commission should entertain any idea as to the propriety of a segregation of ground or pulverized industrial sand on the one hand from unground industrial sand on the other," the brief said, "then it is this complainant's conviction that these proceedings, in so far as they are pertinent to that issue, should be reöpened for the purpose of making an adequate record of essential facts and permitting affected interests to be heard in connection therewith.

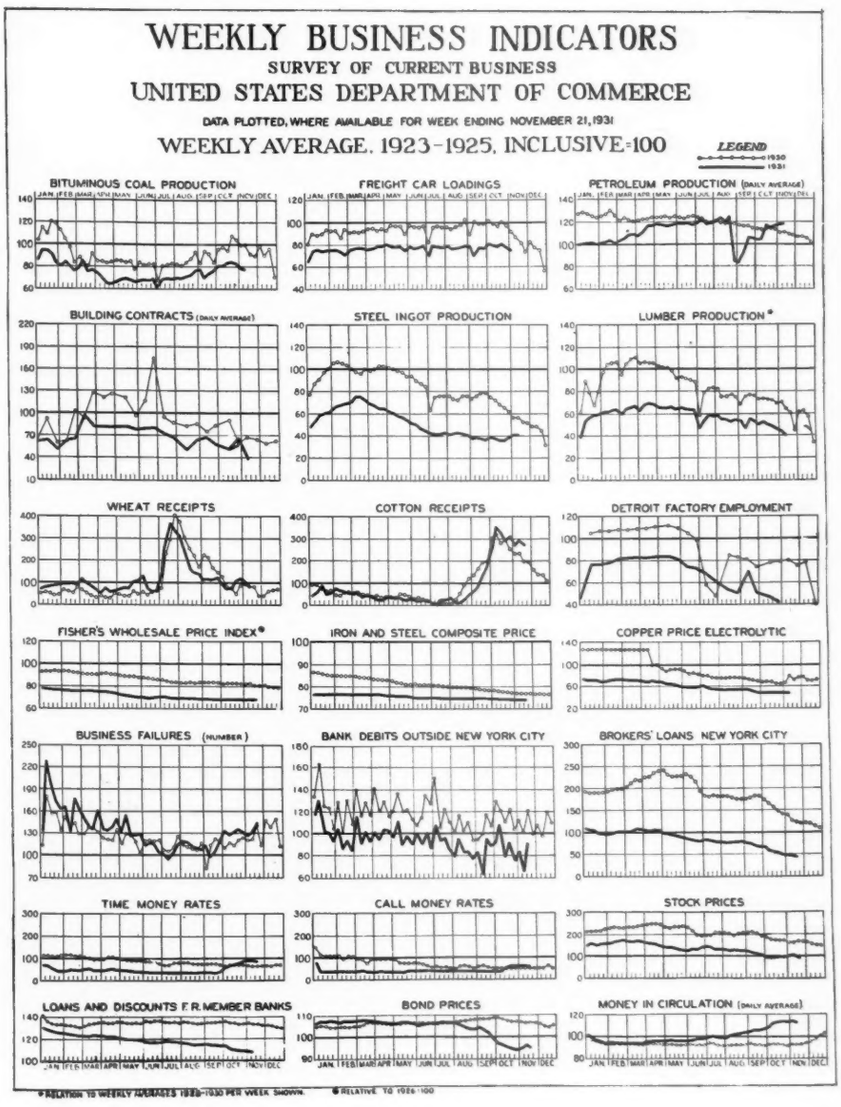
"In the interim the commission should reserve judgment and permit ground or pulverized sand to continue to be associated with, and enjoy the same rate level as is applied to, other unground industrial sands as it always has in the past until such time as the wisdom of the termination of that policy has been definitely and conclusively established."

Adoption of the examiner's report would only result in an adjustment of rates far more chaotic than that now prevailing, the brief said.

"Indeed," the Illinois bureau said, "it is the opinion of this complainant that the interests of the parties concerned in this proceeding would be best served if the tentative report was rejected in its entirety and a new report proposed by the examiner."

Zeesman Corp. Opens Mica Plant in Alabama

The John M. Zeesman Mica Corp., recently formed at Chicago, has opened a branch plant at Lineville, Ala. A two-year lease has been secured on a building which will be converted into a plant for grinding, washing and drying mica. Approximately 30 men and women will be employed. There appears to be a vast amount of mica deposits in Clay, Randolph and Cleburne Counties. John M. Zeesman is at Lineville supervising the installation of machinery. The plant is expected to start operating about Jan. 1.



Financial News

The information contained in these financial pages is given with the understanding that any statement on the part of this magazine or any of its staff, as to the responsibility or standing of any person, firm or corporation, or as to the value of any property or securities is a mere expression of opinion, given as a matter of service to the readers of PIT AND QUARRY, *for which no responsibility in any way is to attach to this magazine or to any of its staff.*

Struckmann Sees Better Times for Cement Mills

Returning from a three-months' business trip to Europe and South America, Holger Struckmann, president of International Cement Corp., reports that the cement industry is giving indications of having turned the corner toward definite improvement, and with sentiment generally better the outlook for 1932 is much improved.

"The price of cement," he said, "is extremely low and any change should mean better prices." Mr. Struckmann, who has been in South America surveying the progress of the company's new plant being constructed at Rio de Janeiro, said that the unit's completion was scheduled for next year and that it would have an annual capacity of about 1,000,000 bbl.

"The future of International Cement in South America is so promising," he said, "that the company's income from this business alone should be ultimately sufficient to cover its dividend requirements. We are firmly established in Uruguay and the Argentine. As soon as the plant at Rio is completed we will commence construction of another unit at Sao Paulo. After many years' effort International has uncovered one of the finest limestone deposits in South America, which will enable the activities of our subsidiary companies to continue to develop uninterruptedly."

Mr. Struckmann pointed out that the company's foreign business, with the exception of Cuba, is being operated at a profit, although earnings are running below a year ago. Domestic business, he said, considering the general depression, is holding up well. He estimated net income for the current year would amount to approximately $2,250,000, as compared with $4,539,509, or $7.14 a common share, in 1930. Although there is a possibility that the $4 common dividend might not be covered for the year, he said the final figure should not fall far below it. The company has no preferred stock. Outstanding bonds at the end of 1930 totaled $17,995,500.

Mr. Struckmann further stated that he looked for many important developments in the industry in the near future.

"It is my opinion," he said, "that as the result of the current depression the cement industry will witness consolidations of the stronger units and the elimination of the weaker ones. This is necessary to bring about greater economy in production and distribution. In any move in that direction International Cement will take an important part."

Estimated net profit, after all charges and taxes, of $2,250,000 is equivalent to around $3.50 a share on the outstanding 636,171 shares of International Cement common stock. As of the close of last December the company had outstanding $17,995,000 of 20-year 5 per cent. convertible debentures, entailing annual interest charges of $899,750. These debentures are currently selling at 75.

For the nine months ended September 30, last, net profit, after charges and taxes, amounted to $1,532,107, equal to $2.41 a share on the outstanding 636,171 common shares. In the corresponding period a year previous, net totaled $3,446,768, or $5.44 a share on 633,452 shares.

Johns-Manville Net in Third Quarter $261,406

Johns-Manville Corp. and subsidiaries report for quarter ended September 30, 1931, net profit of $261,406 after depreciation, depletion, federal taxes, etc., equivalent after dividend requirements on 7 per cent. preferred stock, to 17 cents a share on 750,000 no-par shares of common stock. This compares with $715,657 or 78 cents a share in preceding quarter and $1,202,867 or $1.43 a common share in third quarter of previous year.

Net profit for nine months ended September 30, 1931, was $1,207,174 after charges and taxes, equal to $1.08 a share on common, comparing with $2,943,027 or $3.40 a common share in first nine months of 1930.

Consolidated income account for compares as follows:

quarter ended September 30, 1931,

	1931	1930
Sales	$8,433,091	$12,581,619
Expenses, depreciation, depletion, etc..	8,132,974	11,223,356
Balance	$300,117	$1,358,263
Federal taxes	38,711	155,396
Net profit	$261,406	$1,202,867

Nine months ended September 30:

	1931	1930
Sales	$25,863,353	$38,143,538
Expenses, depreciation, depletion, etc.	24,511,649	34,827,342
Balance	$1,351,704	$3,316,196
Federal taxes	144,530	373,169

Arundel Corp. Earnings Continue at High Level

Arundel Corp. of Baltimore, Md., reports for the nine months ended September 30, 1931, net income of $1,734,387 after depreciation, federal taxes, etc., which is equivalent to $3.50 a share on 495,556 no-par shares of common stock. This compares with $1,957,100, or $3.97 a share, on 492,556 shares in the first nine months of 1930. September net income was $210,396 after charges and taxes against $193,807 in September, 1930.

Current assets on September 30, 1931, amounted to $4,444,292 and current liabilities $522,688 comparing with $6,084,048 and $379,977, respectively, on September 30, of previous year.

Plans $50,000 Concrete Plant at Toronto, Ont.

The Dual Mixed Concrete & Materials Co., Ltd., located at the foot of Bathurst St., in Toronto, Ont., has announced plans for the construction shortly of a $50,000 concrete-mixing plant.

CURRENT DIVIDENDS

Company	Class of Stock	Dividend Rate	Holders of Record	Payable	Company	Class of Stock	Dividend Rate	Holders of Record	Payable
Calaveras Cement	Preferred	$1.75 qr.	.....	Oct. 15	Monolith Portland Cement	Common	$0.40 S.A.	.....	Jan. 2
Canada Cement Co	Preferred	$1.62½ qr.	Nov. 30	Dec. 31	Pacific Portland Cement	Preferred	$1.62½ qr.	Sept. 30	Oct. 5
Cleveland Quarries Co	Common	$0.25 qr.	Nov. 10	Dec. 1	Pittsburgh Plate Glass	Common	$0.25 qr.	Dec. 10	Dec. 31
Giant Portland Cement	Preferred	$1.75 S.A.		Dec. 15	Port Huron Sulphur	Common	$0.15 qr.	Oct. 15	Nov. 1
International Amiesite	Preferred	$1.75 qr.	Nov. 20	Dec. 1	Raybestos-Manhattan	Common	$0.40 qr.	Nov. 30	Dec. 15
International Salt	Common	$0.75 qr.	Dec. 15	Jan. 2	Raymond Concrete Pile	Preferred	$0.75 qr.	Oct. 20	Nov. 1
Johns-Manville	Common	$0.75 qr.	.....	Oct. 15	Riverside Cement	1st Pfd.	$1.50 qr.	Oct. 15	Nov. 1
Kelley Island Lime & T	Common	$0.50 qr.	Sept. 24	Oct. 1	Schumacher Wallboard	Preferred	$0.50 qr.	Nov. 5	Nov. 15
Kentucky Rock Asphalt	Preferred	$1.75 qr.	Dec. 10	Jan. 2	Superior Portland Cement	Class A	$0.27½M	Nov. 23	Dec. 1
Lehigh Portland Cement	Preferred	$1.75 qr.	Dec. 14	Jan. 2	Texas Gulf Sulphur	Common	$0.75 qr.	Dec. 1	Dec. 15
McWilliams Dredging	Common	$0.37½ qr.	Nov. 15	Dec. 1	United States Gypsum	Common	$0.40 qr.	Dec. 15	Dec. 31
Missouri Portland Cement	Common	$0.25 qr.	Oct. 22	Oct. 31	United States Gypsum	Preferred	$1.75 qr.	Dec. 15	Dec. 31
Monolith Portland Cement	Preferred	$0.40 S.A.	.....	Jan. 2	Worcester Salt	Preferred	$1.50 qr.	Nov. 9	Nov. 16

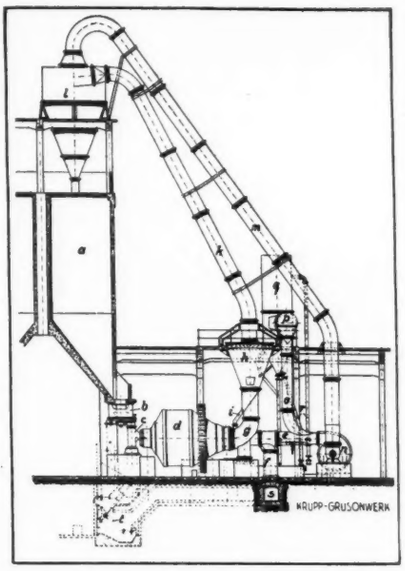
Review of Foreign Practice

German Mill Also Dries Shaft-Kiln Cement Mix

The air-swept unit tube-mill and drier which has found such extensive use for preparing pulverized coal has recently been introduced into other industries, including the preparation of the cement raw-mix for shaft kilns. The first installation of this sort in Germany was made some time ago by the Fried. Krupp Grusonwerk A.G. for the Wittekind cement works at Erwitte, and has given excellent results. The raw material, a hard lime-marl, is reduced by a jaw crusher to 300 mm. (12 in.) and below, mixed with the coke that serves as fuel for the burning, and the mix reduced to 0-80 mm. (3.2 in.) in a hammer mill. This mix is then elevated to the feed bin *(a)* for the grinding mill. An air-tight enclosed table feeder *(b)* and chute *(c)* feed the stone and coke mix into the mill *(d)*. There the material is ground and passes through a slotted wall into the separating chamber. Scoops throw the ground material into the current of air, which carries away the fines, while the coarse is returned to the grinding chamber by means of a dipper device. The air current carries the fines to an air separator *(h)*, from which the coarse is returned to the mill by means of a chute *(i)*, while the fines are lifted to a cyclone *(l)* above a bin adjoining the raw feed bin. There the material separates from the air and drops to the bin, while the air returns through the conduit *(m)* to the main fan *(n)* and the cycle is repeated.

For evaporating the water contained in the raw mix hot gases are furnished by a traveling grate *(t)* through a tunnel *(s)*, joining the air current just before its entry to the mill. Exhaust air in quantities corresponding to the hot gases added is withdrawn from the air current through the conduit *(o)*, at the same time producing the partial vacuum which sucks hot gases from the grate. This exhaust air is driven by the fan *(p)* into a wet dust-removing device *(q)*. The air is thus thoroughly cleansed and the water used in this separator is used again to moisten the raw mix at the entrance to the shaft kiln, so that all dust is completely recovered.

Some of the data pertinent to the installation are: Raw material, size 0 to 80 mm., moisture 4 to 6 per cent. Mill, inner diameter 3 m., charge 18 tons of 40 to 80 mm. diameter, revolution 18.5 r.p.m., power consumption 275 hp., output 18 to 22 metric tons per hour, according to fineness. Fineness of product, 4 to 25 per cent. residue on 4900-mesh screen (175 mesh per lin. in.), as desired, average 22 per cent.; moisture 0.4 to 0.8 per cent. Hot gases added, 7500 to 8500 kg. per hour, 310 to 500 deg. C., according to dampness. Main fan furnishes 45,000 cu. m. of air per hour, power consumption 125 hp. Temperatures, circulating air at mill entrance 115 deg. C., at mill exit 78 deg. C., exhaust gas at entrance to wet separator at 60 per cent saturation 55 deg. C. Water evaporated, 600 to 1000 kg. per hour. Heat consumed, 900 to 1000 calories per kg. of evaporated water. One man can operate the entire installation.—Wilhelm Jaedel in *Tonindustrie-Zeitung* 55:1147-1149, Oct. 12, 1931.



Sectional view of unit tube-mill, drier and associated equipment.

"Blast-Furnace" Cement Recalled by Anniversary

A booklet issued by the Zementfabrik Thuringia at Unterwellenborn, Germany, on the occasion of its twenty-fifth anniversary contains some interesting facts about the history not only of the company but also of the German cement industry. The company was founded by Paul Prüssing, son of Godhard Prüssing, who previously had been a member of the Vorwohler company but had left it because of opposition to his belief that Portland cement could be improved by the addition of combinable silica. In 1886 he established a Portland cement plant at Göschwitz a.S., but because of illness and age passed on the working out of his ideas on the use of silica to his sons, particularly Paul, who to further these ideas formed the Zementfabrik Thuringia, Unterwellenborn, and became its first president (1906). The plant, construction of which began in October, 1906, consisted of a dryer for blast-furnace slag, a shaft kiln for burning Portland cement, and a grinding plant. The raw material for the Portland cement was obtained from Göschwitz in the form of briquettes. The new cement reached a strength of 350 kg. after 28-day water storage, which was twice the standard specified requirement of the time, and in spite of the usual lack of confidence in a new material, production grew from 8,000 tons the first year to around 34,000 tons in the two years before the War. Prüssing christened the cement "blast-furnace" cement, indicating its origin and composition. Production after the war naturally suffered, but had reached the pre-war figure by 1926.

Because of special resistance to various chemical attacks, Thuringia blast-furnace cement has always had its market principally for such uses as chemical plants, mines (especially the German potash mines), drainage channels, construction in aggressive soils, etc. — *Tonindustrie-Zeitung* 55:1164-1165, Oct. 15, 1931.

Sand-Lime Brick Should Be Hardened Immediately

Since the early days manufacturers of sand-lime brick have been concerned with the question whether prolonged standing of the raw bricks before hardening was harmful. Practical experience favored immediate hardening, and researches which have been carried out in the Chemische Laboratorium für Tonindustrie establish the correctness of practical experience. Bricks which were hardened immediately had an average compressive strength of 180.4 kg. per sq. cm. Bricks which were made in the same factory at the same time, but had stood in the air 24 hours before hardening, showed an average compressive strength of only 124.7 kg., and bricks that had stood 48 hours showed an average compressive strength of 116 kg. It was also observed that the brick surfaces exposed to the air showed an ochre-yellow color, while those manufactured in the regular way were the normal white.

Even though it is generally recognized that standing is harmful, conditions of manufacture do not always make it practical to put the raw bricks in the kiln at once. In such a case the bricks can be protected against harmful drying-out by sprinkling them thoroughly as they stand on cars outside the kettles.

Besides the decrease in strength, standing in air is harmful to the bricks in other ways. The dried surfaces even after hardening are for instance less resistant to the action of frost, and if they are used on outer surfaces are likely to be damaged in freezing weather. Everything points to the desirability of hardening the bricks immediately.—B. Krieger in *Tonindustrie-Zeitung* 55:1162, Oct. 15, 1931.

Manufacturers' Publications

Each publication listed below contains information of interest to nonmetallic mineral producers. Readers may obtain, without charge—except where a price may be stated—and without obligation, copies of any of these publications by writing directly to the manufacturers who publish them. Please mention PIT AND QUARRY *when writing.*

Blasting

"Cordeau Connectors." 1 p. *(The Dupont Magazine* for November. E. I. duPont de Nemours & Co., Inc., Wilmington, Del.) Describes and illustrates a new spring-clip connector for effectively detonating Cordeau-Bickford fuse, eliminating slitting and wrapping the "down" line around the trunk line. Written in an interesting manner by Arthur LaMotte, manager of the technical section of the explosives department.

Boilers

C-E Multiple Circulation Boiler. 4 p. (Bull. MC-1. Combustion Engineering Corp., New York, N. Y.) Describes and illustrates a bent-tube boiler, designed to provide the positive and unrestricted circulation so important in modern boiler practice with its high steam pressures, high temperatures and high rates of evaporation. This boiler is available in sizes ranging from 2,000 sq. ft. to 26,000 sq. ft. of heating surface. It is adaptable to any type of firing and may be set double.

Instruments

Recording Instruments. 20 p. (Bull. GEA-1061D. General Electric Co., Schenectady, N. Y.) Describes and illustrates recording meters in switchboard and portable types for measuring alternating and direct current.

Lubricating Devices

Oil Cups, Automatic Multiple Oilers and Oil Seals. 120 p. (Cat. No. 31. Gits Bros. Manufacturing Co., Chicago, Ill.) Describes and illustrates a complete line of equipment for the lubrication of machinery. Full-size illustrations, together with sectional drawings, dimensions and details of the 700 items listed make this a most complete catalogue of oil cups, oil seals, etc.

Materials Handling

Hoisting and Conveying Equipment. (Cat. No. 15. Wright Manufacturing Co., Bridgeport, Conn.) Describes in condensed form the equipment for hoisting and conveying purposes made by the company. Included are chain hoists, trolleys, trolley hoists, traveling cranes, jib cranes and electric hoists.

Mechanical Stokers

Condensed Catalog of Mechanical Stokers. 40 p. (Stoker Manufacturers Assn., Detroit, Mich.) Forty-eight different types of mechanical stokers, manufactured by the fourteen member companies of the association, are illustrated and described, being grouped into the following classifications: multiple retort underfeed stokers, single retort underfeed stokers, chain grate stokers and overfeed stokers. The text is limited to engineering descriptions of the various types of machines. A supplementary section on engineering data relating to modern stoker practice is included.

Power Transmission

The Lindahl Line of Pulleys and Sheaves. 64 p. (Cat. No. 24. Henry Lindahl Foundry & Machine Co., Chicago, Ill.) Describes and illustrates a complete line of pulleys and sheaves for the transmission of power. Includes hoisting sheaves and complete V-belt drives.

The Weatherly Multiple V-Belt Drive. 64 p. (Cat. No. 102. Weatherly Foundry & Machine Co., Weatherly, Pa.) A comprehensive data book for engineers and operators, explaining the method of designing V-belt drives and setting forth in tabulated form certain standard ratio drives from a fractional to several hundred horsepower. Data on standard Gilmer belts and regarding the machining of V-groove sheaves are also included.

Refractories

Pyro-Mortar. 4 p. (The Quigley Co., Inc., New York, N. Y.) Describes a dry refractory cement for bonding fire-brick, reclaiming eroded furnace walls, etc.

Screening

Rol-Man Screens for Revolving Equipment. 20 p. (Bull. 230. The Manganese Steel Forge Co., Philadelphia, Pa.) Outlines and illustrates the advantages of a double-lock, manganese-steel screen, giving detailed information regarding methods of application to various types of revolving equipment.

Washing

The Hardinge Conical Scrubber for Washing Sand and Stone. 4 p. (Hardinge Co., Inc., York, Pa.) Describes and illustrates the application of a conical mill to scrubbing sand, gravel and stone.

Miscellaneous

Foundry and Machine Work. 24 p. (Weatherly Foundry & Machine Co., Weatherly, Pa.) Describes and illustrates this concern's facilities for casting, machining and fabricating a wide variety of mill equipment. Of particular interest is that part of the text and illustrations regarding the manufacture of cement-plant and mining machinery.

Obtaining the Maximum Service from Bucket-Elevator Equipment

Harking back over his more than 15 years of experience in the selection, erection, maintenance and servicing of various types of bucket-elevators, Ralph McMillan, construction superintendent, Link-Belt Company, suggests that the following seven points be observed in order to maintain maximum service:

1. *Avoid Overloading.*—In selecting a bucket-elevator for a given purpose, the specifications of the material to be handled and the quantity to be elevated during a given time, with regard to the greatest load at any one interval, should be known. From this, an elevator designed to give the longest efficient service will be obtained. If the plant's capacity is expected to increase in the future, this fact should be borne in mind and the original elevator chosen to care for this anticipated capacity.

2. *Roominess.*—Sufficient room in the elevator casing is essential to long life, as ample space does away with the wear of buckets on the casing, and its resultant depreciation. Pits for the elevators should always be roomy to allow quick and easy access for adjustments, cleaning of the boot, and lubrication.

3. *Uniform Feed.*—On centrifugal-discharge elevators the receiving point should be well up above the foot shaft so that the major portion of the material is discharged directly into the buckets. A uniform feed is essential because the elevator will choke and stop if overloaded. This applies to continuous-bucket elevators as well.

4. *Proper Discharge.*—Make sure that the discharge chute is of ample proportions, and placed at a suitable slant or angle, to insure immediate freeing of material, without danger of its backing up to the line of buckets.

5. *Driving Mechanism.*—A positive drive gives the best results, and this may be accomplished through the use of several efficient methods, some of which are illustrated. The use of these drives eliminates much of the usual noise and vibration, as well as annoyance of the elevator.

6. *Lubrication.*—The best methods include pressure systems and the use of take-ups, pillow blocks, etc., having ample grease- or oil-storage facilities. Drives running in oil- or dust-tight casings give longest service.

7. *Danger.*—When you hear material dropping down the elevator casing you know it is time to stop the elevator and investigate, as something must be wrong. If you don't know what to do, consult any bucket-elevator manufacturer's engineer or service man.

New Machinery and Supplies

Cordeau Connectors Aid in Fuse-Line Hook-Ups

The use of Cordeau-Bickford fuse for firing well-drill and coyote holes has increased greatly in recent years. In a well-drill hole Cordeau practically constitutes a continuous electric blasting cap from the top to the bottom of the charge. This assures complete detonation and also allows the charge to be broken, when necessary, so that stemming material may be placed between units of dynamite.

The customary method of firing well-drill blasts with Cordeau is to use double-countered Cordeau in the holes and plain Cordeau as a trunk line on the surface. Heretofore, making connections has involved a considerable amount of rather delicate work. It has been necessary to slit the top of the "down" or branch line for a distance of 6 in. to 8 in. and then to wind the two halves in opposite directions around the trunk line as tightly as possible. (See Fig. 1.) Connecting a large number of holes in this manner takes time, especially if it is raining, snowing or sleeting to add to the blaster's discomfort. Moreover, if the T. N. T. gets wet, the branch line is likely to fail.

To obviate these difficulties, the E. I. du Pont de Nemours & Co., Inc., has developed a Cordeau connector which does away with slitting and wrapping the down line around the trunk line, according to Arthur La Motte, manager of the technical section, explosives department. This device consists of two parts—a clip made of spring steel (Fig. 2) and a special cap made of copper having a bead at one end and resembling somewhat a rimfire rifle cartridge shell (Fig. 3). The upper end of this cap, as shown in Fig. 4, is filled with an explosive mixture similar to that in blasting caps, and this is held in place by an inner capsule having a minute central aperture. This capsule serves both to confine the charge and to prevent the lead tube from coming into contact with the explosive mixture.

To use this device, the copper cap is dropped through the aperture in the clip, as in Fig. 5. The freshly-cut end of the Cordeau is then inserted in the lower open end of the cap until it touches the inner capsule, whereupon the cap is crimped fast to the Cordeau as in Fig. 6. After a connector has been attached to the Cordeau extending from each bore hole, the trunk line is laid between the wings of the clips, one by one, and the clip is sprung open with the fingers, as in Fig. 7. The Cordeau drops into contact with the loaded end of the cap and is held firmly in place, as shown in Fig. 8.

This device offers several advantages. First, it makes a waterproof connection; after the cap and clip have been crimped on the down line of the Cordeau, rain, snow and sleet cannot affect it. Second, the connection is made much more quickly than by the former method. And third, the device is simple, easy to use and effective, regardless of what the weather conditions may be.

In a word, it aids the blaster, saves time and gives greater assurance of detonating all the down lines joined to a Cordeau trunk line.

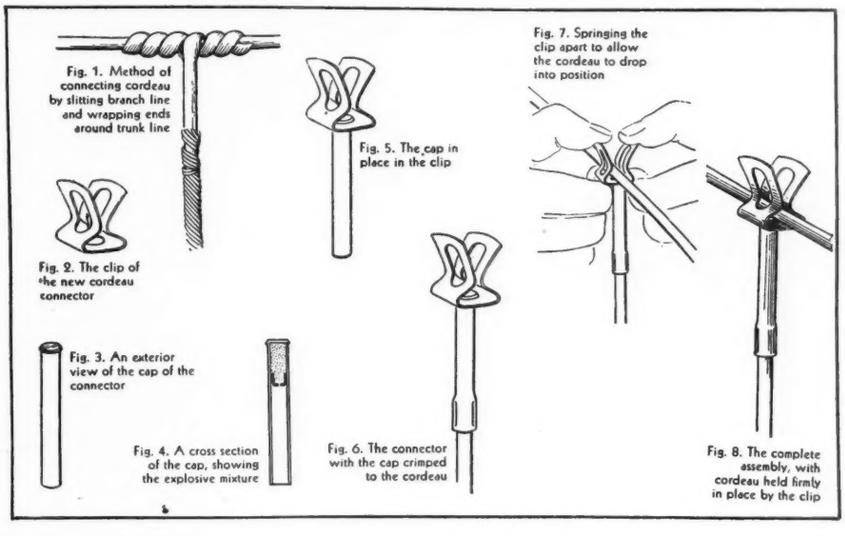
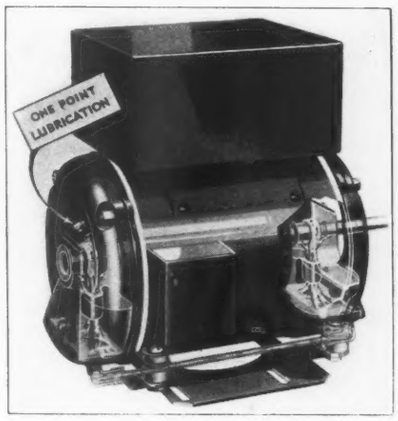


Fig. 1. Method of connecting cordeau by slitting branch line and wrapping ends around trunk line
Fig. 2. The clip of the new cordeau connector
Fig. 3. An exterior view of the cap of the connector
Fig. 4. A cross section of the cap, showing the explosive mixture
Fig. 5. The cap in place in the clip
Fig. 6. The connector with the cap crimped to the cordeau
Fig. 7. Springing the clip apart to allow the cordeau to drop into position
Fig. 8. The complete assembly, with cordeau held firmly in place by the clip

New Oil Well Features Small Electric Motors

Automatic oiling is offered in connection with the new fractional-horsepower, condenser-start, induction-run motor manufactured by the Howell Electric Motors Co., Howell, Mich.

This new electric-motor feature has two oil wells, one for each bearing, each having a reserve capacity of 2 cu. in. of oil. This is ample to provide proper lubrication over an extremely long period of time without adding new oil or giving it further oiling attention. These wells are filled at the factory with S.A.E. 20 oil. Each well is connected with the other at the bottom by pipe line giving the advantage of one point lubrication through this self-leveling feature. Its shape and design are such as to make it non-spillable no matter what position the motor is in.



Phantom view of motor showing one-point lubricating system.

Each sleeve bearing is wool-yarn packed and has a wick running to the bottom of the well, which carries oil from the reserve supply to the bearing only as needed, permitting the shaft to roll on a thin film of oil at all times.

In addition to the above, this motor offers the advantages of quiet operation. Through its indestructible squirrel-cage rotor, it reduces construction to its simplest form. Its high torque assures smooth, quiet starting which is maintained throughout the life of the motor. In a word, it is a single-phase motor with polyphase simplicity.

Low-Friction Apron Gate Works on New Principle

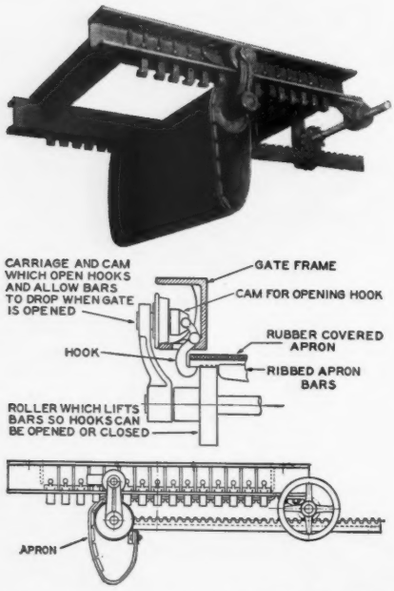
A new low friction type "apron gate" recently designed and built by Stephens-Adamson Mfg. Co., Aurora, Ill., is compact, light in weight, inexpensive and can easily be operated by one man.

The gate opening is closed by a series of reinforced cross bars, covered with a wear-resisting rubber apron. In closing the gate, these bars are lifted one by one and hooked into place. A rack and pinion moves the operating carriage backward and forward to open and close the gate.

In opening, the carriage is pulled backward, causing the two lower rollers to lift the apron bars slightly and disengage the hooks. In closing, the

carriage is pushed forward, the cams open the hooks, the rollers lift the apron bars into place, the hooks engage and the gate is closed.

This gate is much easier to operate than plain slide or quadrant gates for the reason that the weight of the material is evenly distributed among the bars. The effort necessary to open the gate is the comparatively small


CARRIAGE AND CAM WHICH OPEN HOOKS AND ALLOW BARS TO DROP WHEN GATE IS OPENED
GATE FRAME
CAM FOR OPENING HOOK
RUBBER COVERED APRON
HOOK
RIBBED APRON BARS
ROLLER WHICH LIFTS BARS SO HOOKS CAN BE OPENED OR CLOSED
APRON

Apron gate partially opened to show how the apron drops from under the load without friction. Drawings show how the apron bars are held in place, and how they are released when the gate is opened.

exertion it takes to unhook one bar at a time, while on slide type gates the slides or quadrants must be moved against the friction caused by the load resting upon the entire gate opening.

In walking through some storage plants you will notice surplus water dripping constantly from gates, which sometimes makes it unpleasant. The new apron gate is so designed that a drain can easily be attached to catch the surplus water.

The new low-friction-type apron gate is ideal for use in connection with coal bunkers, crushed-stone, sand-and-gravel plants and all classes of storage bins where a large opening is needed.

Among the advantages of the new apron gate are: easy operation, light weight, durability, low cost and low headroom requirement.

Higher Rated Capacity in New Electric Plants

Two new Kohler electric plants, each of which offers twice the capacity of any of the 100 other different models in this line of portable, automatic power and light units, are announced by the Kohler Company, Kohler, Wis.

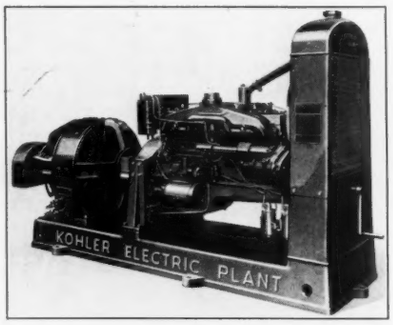
Twenty kw. direct current and 25 kv.a. alternating current are delivered, respectively, by the two new plants, which have been developed to meet special needs, such as emergency installation on barges, dredges and about plants and quarries.

Installed for emergency service in time of stress, the plants will provide current if the main generators fail.

In construction and in operation, the 20 kw. and 25 kv.a. plants resemble 5 and 10 kw. Kohler units. The new plants are powered by six-cylinder, heavy-duty industrial engines of the L-head type, with removable cylinder heads. An extra heavy crankshaft is supported by seven main bearings and full pressure oiling is used to all engine bearings.

Cooling is by means of a large size radiator and water circulation pump. The radiator fan is driven by double V-belts, either of which is of ample size to drive the fan. Two are used, however, as a safety factor.

The starting system of the new plants is 12 volt and is controlled by a special relay system in order that the unit may be started and stopped by the closing or opening of a two-wire starting circuit. The plant will



The new generating unit.

start and will continue to run as long as this circuit is closed. A 12-volt starting battery is kept charged automatically by a generator mounted on the side of the engine.

Standard 110 or 220-volt current is generated. The d-c. generators are of the revolving-armature, compound-wound type and the a-c. generators are of the stationary-armature and revolving-field type with a direct-connected exciter. All models are furnished with or without a switchboard.

General-Purpose Lathe for Maintenance Service

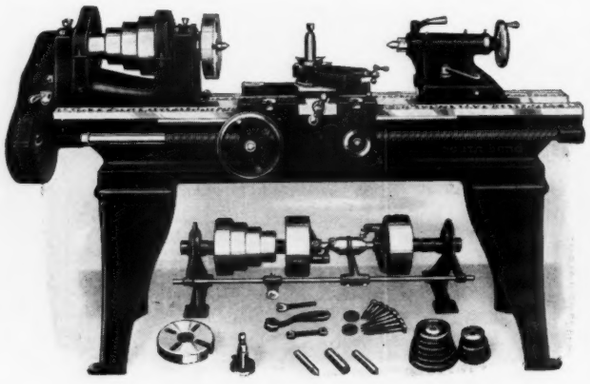
A new general-purpose lathe especially designed for light manufacturing, for general machine shop and for maintenance-shop work has just been added to its "junior" line by the South Bend Lathe Works, South Bend, Ind.

The new lathe, called the Sixteen Inch Junior, has a 16-in. swing which permits the handling of large diameter work. As it is available in bed lengths of from 6 to 12 ft., this equipment unit will also handle work of unusual length. There has been a simplification in construction and design and the lathe has been relieved of non-essential, expensive features not needed in general machine shop work.

It is a back-geared, screw-cutting lathe with automatic longitudinal feed and eight changes of spindle speed. All standard screw threads may be cut, from 2 to 40 per in., right or left hand, including 11½ pipe thread. The headstock spindle is made of a special carbon steel, finish ground, with a 1⅜-in. hole through its entire length.

Bearings are of phosphor bronze and adjustable for wear. The tailstock has a set-over for taper turning, graduated spindle, improved binding plugs and hardened center. The compound rest will swivel to any angle and has an angular travel of 3¼ in.

The lathe may be had in countershaft drive or in various types of motor drive to fit the needs of any shop. Safety, economy and convenience of operation are features pointed out by the manufacturer. Full particulars and mechanical description are given in the new General Catalog No. 92, recently issued by the South Bend Lathe Works.



The 16-in. machine-shop lathe.

Asphaltic-Gravel Plant Prepares Road Material

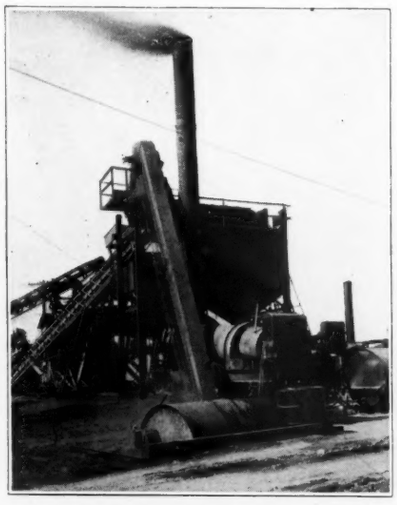
For some time past Macomb County, Michigan, has been engaged in resurfacing its 200 mi. of gravel roads with asphaltic gravel. For economical reasons aggregates obtained from county-owned gravel pits, properly crushed, are utilized in a mixture which contains from 5 per cent. to 6 per cent. of asphalt.

For the economical preparation of the asphaltic gravel the Macomb County Board of Road Commissioners purchased what is known as a "road-oil pre-mix plant" manufactured by the Iowa Mfg. Co. of Cedar Rapids, Ia., and equipped with Hercules power units built by the Hercules Motors Corp., Canton, Ohio. This equipment was remodeled somewhat to meet the specific

needs of the Macomb County project.

As described by Leon Luke, engineer of Macomb County Road Commission, this plant consists of two 20-cu. yd. bins, one for raw aggregates and one for the finished product; a 30-in. diameter oil-burner drier; a bucket-conveyor; a pug-mill equipped with a weighing device for aggregates and asphalt; and asphalt steam-heating unit; a 1,500-gal. storage tank for asphalt; and a 1,000-gal. asphalt tank mounted on a 3½-ton truck for transporting hot apshalt from the railroad siding to the plant.

The gravel is heated to a tempera-



Plant which prepares asphaltic gravel for road-surfacing.

ture of 250 deg. to 300 deg. F. in order to drive off all moisture and thus develop the maximum bond. It is then mixed in the pug-mill with the hot asphalt.

Much of the aggregate used in the early operation of the Macomb County plant came from a wet pit, approximately 50 ft. under water. This, of course, retarded somewhat the process of heating and drying. However, an output of 20 to 25 cu. yd. per hr. was the average over a considerable period when wet materials were being used. Mr. Luke estimates an output of 30 cu. yd. per hr. with materials from a dry pit.

Gravel roads resurfaced with asphaltic gravel have the appearance of asphaltic concrete except that some of the stones appearing on the surface are coarser.

Named Representative in Pittsburgh Trade Area

The Beckwith Machinery Co. of Pittsburgh has contracted to handle the complete line of shovels and cranes in sizes from 1¼ cu. yd. to ⅜ cu. yd. manufactured by the Byers Machine Co., Ravenna, O. Its territory will include western Pennsylvania, southeastern Ohio and counties in West Virginia within 100 miles of Pittsburgh.

Forgetting Production Costs in the Mad Scramble for Business

By RALPH H. BUTZ

"IT is conservatively estimated," explained E. B. Lehr, general manager of the Allen Quarries Co., Allentown, Pa., "that a million tons of crushed stone and slag have been used in Pennsylvania following Governor Pinchot's order to resurface and improve all the highways in the state. This is a tremendous amount of material and should have been of direct benefit to the quarrying interests of the state. As a matter of fact, it seems that very little of this business was handled at a profit."

The Allen Quarries Co. is owned by C. O. Hunsicker, who for many years was one of the most extensive builders in this part of the state. Their equipment consists of modern machinery and their production cost compares favorably with that of the largest producers.

"Has this business actually been taken at less than cost?" I asked Mr. Lehr.

"Apparently the matter of cost hasn't been a factor in bidding for these contracts," he replied. "If some of these bidders have any knowledge of their production costs they must have forgotten them in preparing their bids. We have been keeping a cost accounting system as devised by the National Crushed Stone Assn., and while some producers in our territory may be able to produce crushed stone at a slightly lower cost, they could not possibly produce at the prices they quoted. It has been a case of robbing Peter to pay Paul."

"That," I said, "doesn't sound promising for the producers next spring when this road building program will go forward with renewed effort?"

"Not unless there is a better understanding among the producers," asserted Mr. Lehr. "If it is a matter of competition based on actual costs, then there should be some general improvement in the entire industry. Every producer will benefit to a certain extent. But if this year's policy continues the man who gets the business will lose the most."

"Who," I inquired, "are these operators that seem to care so little about profits in particular and the industry in general?"

"The most glaring example of inconsistency," said Mr. Lehr, "is one of the largest corporations in the East. Crushed-stone production is merely a sideline with this concern, and yet they are able to produce tremendous quantities in their quarries. If their production cost is any indication of their selling price, then a large part of their operating costs and overhead are charged to one of the main departments of their business. While the cost of this plant was probably charged to depreciation during the boom years, they still have to include maintenance expense in their cost figures. Their method of marketing has had a demoralizing effect upon the industry in this part of the State."

A view of the Allen Quarries Co. plant.

Parent Company Absorbs Fuel-Equipment Concern

The Grindle Fuel Equipment Co., for the past ten years a subsidiary of Whiting Corp., has been absorbed by the parent company and from now on will be operated as a separate department under the name, "Pulverizing and Combustion Equipment Division."

The company offers what is probably the most comprehensive line of pulverized-coal equipment in this country. In addition to the impact type of pulverizer in use for many years it has lately introduced a much improved type of table-roller pulverizer and a new ball mill.

W. R. Bean, formerly president of Grindle Fuel Equipment Co., has been made a vice-president of Whiting Corp., in charge of the newly-formed Pulverizing and Combustion Equipment Division. He is assisted by an able and experienced staff, including several of the country's foremost pulverized-coal engineers.

Power-Plant Firm Opens Offices in Washington

The Foster Wheeler Corp. announces the opening of a branch office in Washington, D. C. The office is equipped to handle inquiries for stationary and marine power-plant equipment, and in general all products of the corporation. J. S. Malseed, a sales engineer of long experience, has moved from New York to Washington and will be in charge of the new office. The address is 726 Jackson Place, N. W.

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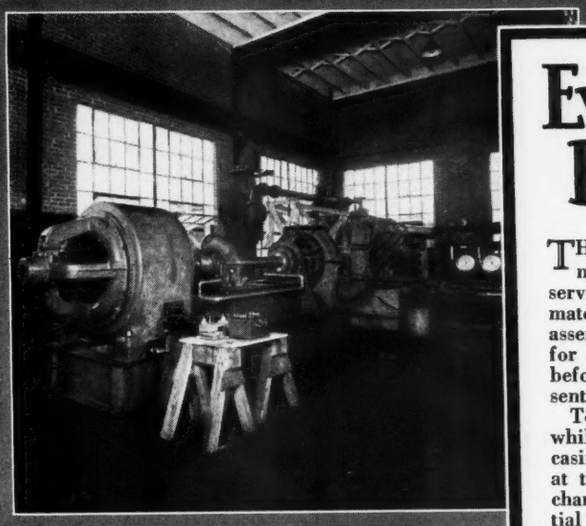

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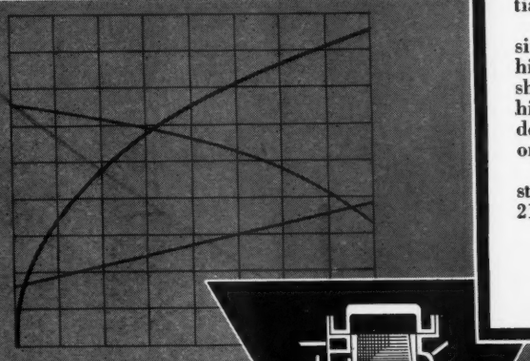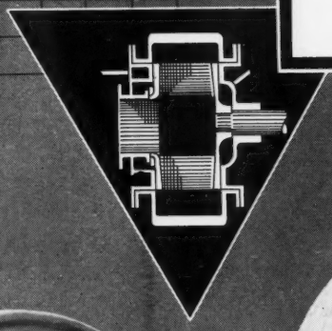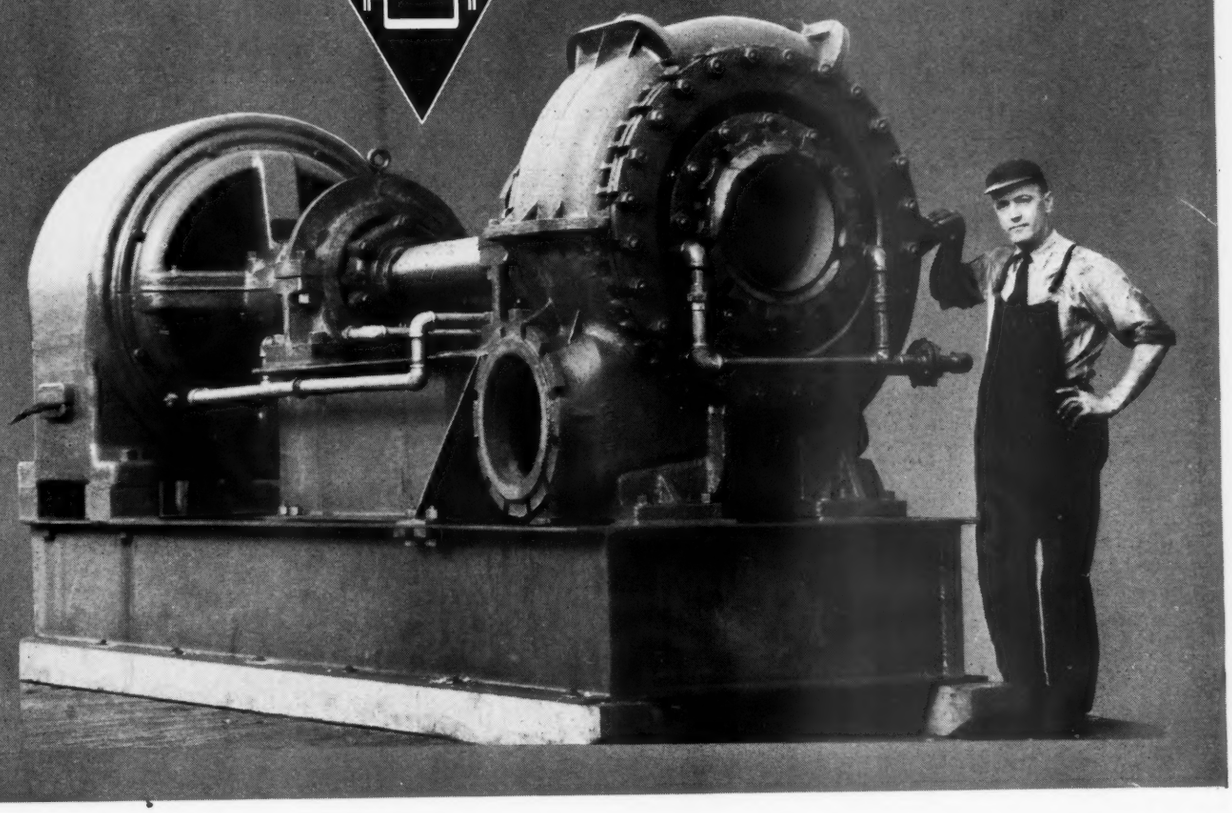
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